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OUTDOOR NATURE STUDIES

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One member of each group of two in the third grade pictured on the cover was "shadow-maker." His partner, armed with paper strips and pebbles, marked the length and the direction of the shadow. Fifteen minutes later, each "shadow-maker" returned to his place (marked with pebbles). The picture on page 64 shows how "My shadow grew longer and bent that way," during the interval.

Contents

Acknowledgment

The writer of this Leaflet acknowledges the contributions of those persons whose names appear as authors of certain sections.

Part of a kindergarten group gathered to discuss their "specimens."

Outdoor Nature Studies

By EVA L. GORDON

MANY years ago Louis Agassiz, a Swiss geologist and teacher of natural history, came to America to study and to teach. One of his great contributions to American science teaching was embodied in his famous dictum, "Study nature, not books." In this connection, Agassiz once said, "Whenever we study books we are one remove away from the things that we would be better acquainted with." (From remarks made by Louis Agassiz, Professor at Harvard University, at the opening of the Anderson School of Natural History, on the Island of Penikese, on July 8, 1873.)

Agassiz no doubt meant by his statement to emphasize the supreme value of first-hand experience and of learning "to find out what you want to know for yourselves," by direct observation. He seems to have allowed his students to turn to books after he was certain that they had learned to observe well. Probably, it can be said that he actually approved studying nature *and* books.

One aim of science teaching, especially at elementary levels, is "to create in children an interest in and an appreciation for the world in which they live." (From *Methods and Activities in Elementary-School Science,* by Glenn O. Blough and Albert J. Huggett, page 22.) What better way is there to achieve this objective than to put in practice Agassiz's simple direction, and to use the world outside our schoolroom doors as an additional classroom in which the objects and happenings of the natural world can be observed and studied in their natural settings and in their normal relationships?

Certainly it seems that a complete science program must utilize indoor and outdoor studies of real things and phenomena; and must involve guided learning both through the use of one's own senses and with the help of books and other classroom materials. That this concept of a science program is widespread is indicated by the article entitled, *Elementary School Outdoor Classroom,* on pages 6 and 7 of this Leaflet. As this article points out, outdoor studies can make textbook work more meaningful and can give new zest to indoor studies. They can also add greatly to the children's acquaintance with and understanding of their own environment. For some children, at least, such experiences will open valuable new areas of leisure-time activity and lifelong interests.

Elementary School Outdoor Classroom[1]

A SCIENCE program which confines itself to the textbook and stays within the school room walls is not a dynamic or stimulating one. Every environment has something to offer. If the children can be trained to see their environment in relation to the text, the printed page becomes more meaningful.

At all seasons of the year, there is something worth while to do and see out doors. The skillful teacher takes advantage of every opportunity presented by the environment. Perhaps some general suggestions will point the way to a few of the many possibilities available in the larger classroom outside the school building.

Are the children in your class learning to identify trees? Shall they learn the names of the trees illustrated in the text or the ones in the school yard and neighborhood? A study of wild flowers may be your unit in the spring. Have you ever noticed how misleading pictures can be in giving a concept of size? Often a trillium and violet look the same size in pictures. A trip to a woods, field, mountain, meadow, or desert will stimulate an interest far beyond the use of visual material alone. The flowers in pictures take on their proper proportions after a trip has been taken to see them in their natural habitat. If space is available, garden activities motivate a study of how plants grow.

Your class may be interested in birds. Bird walks will stimulate this interest. Since it is often difficult to see many birds with a large group on a field trip, encourage the children to take trips in small groups or individually.

Some teachers feel that at least once during the spring, it is worthwhile to meet the children for an early morning walk when the birds are more active. It was just such a teacher, in Jamestown, New York, that encouraged Roger Tory Peterson, the well-known author and artist, in the field of ornithology.

Insect study is greatly stimulated by trips into the field. Children enjoy such an expedition when armed with homemade nets and killing jars. In areas of winter snow, a trip to identify animal tracks may initiate a unit on how animals spend the winter.

Conservation teaching may become very academic if it is confined to the textbook. Look around for possibilities to observe conservation practices in your community.

If you are located in a rural community, you may be able to arrange a trip to see contour plowing or strip farming. Perhaps a reforestation project is near at hand. If a fire tower is located within a reasonable distance of your school,

[1]Prepared by a committee of Cleveland, Ohio, school personnel under the leadership of Grace C. Maddux, Assistant Supervisor of Science, and reprinted by permission from the March, 1953 *Elementary School Science Bulletin*, published by the National Science Teachers Association.

plan with the forest ranger for a convenient time to bring your class. Forest conservation takes on new meaning after such a visit.

The results of a strip-mining operation will indicate to the children the need for conservation measures.

You may live in a part of the country where the economy is based largely on irrigation. Capitalize on the opportunity to see this project in action.

Urban communities may have park areas where there is a need for conservation practices. Perhaps a plan to beautify and conserve the area may be underway. Plan with the children to find out what their community is doing.

Arbor Day presents another possibility for outdoor activities. Planting trees or shrubs in the school yard, city streets, or parks is a practical application of conservation teaching. In some areas, schools cooperated with larger reforestation projects.

An alert teacher will also find many opportunities to enrich the units in physical science. A construction project makes an excellent introduction to the unit on simple machines. A visit to an airport vitalizes a unit on airplanes. With primary children a walk around the neighborhood will raise many questions regarding transportation. An interesting unit may develop from such a trip.

Weather is always present. Direct observations of weather phenomena can be made from the first through the eighth grade. The type of data observed depends on the age and ability of the children. If a Weather Bureau is maintained in your community, the children will profit by a visit to gain first-hand information on how weather reports are gathered and how forecasts are made.

Dams which are built to supply electric power are in the environment of some schools. A visit to such a project will launch a unit on electricity.

Now that spring is here, open your classroom door and with the children explore the environment. Search your own community for all the possibilities which it affords to enrich and stimulate your science teaching.

Some city teachers will feel that the school yard or immediate neighborhood has little to offer. This is often true. However, children in this type of neighborhood need to be aware of even those meager possibilities. If you teach in such a neighborhood, you can exert your influence to encourage the community to provide ways of transporting these children to richer environments.

If you give the possibilities of the "outdoor classroom" a chance this spring, you will not want to close your door next fall or winter. As you plan each science unit with the children, ask yourself, "What can we find outside the classroom that will stimulate interest and increase an understanding of the science learnings in this unit?"

In a Few Minutes, Just Outside the Door

IMMEDIATELY outside most classroom doors is a wealth of material for profitable science studies. Each season offers its own outdoor opportunities for meaningful teaching, and many a useful bit of learning can be achieved in the space of a few minutes spent in the open. Most teachers recognize these facts, and many of the little studies described in the following pages, including the series on pages 10 to 21 under the title, *Through the Year with a Kindergarten Class,* are records of actual trips. No doubt most of you can add to these your own experiences and suggestions.

A survey of almost any school ground discloses a satisfying number of study areas. Often a nearby lawn, garden, park, vacant lot, or roadside supplies additional possibilities. A few exploratory excursions with a class are almost certain to enlarge the list of recognized opportunities, and to give both you and your pupils the satisfaction of having achieved new understandings of your immediate world.

Because daily programs are crowded, and time schedules often impose limitations, the outdoor activities suggested here are planned to take no more than twenty minutes each; many have been accomplished in much shorter periods. Most teachers agree that brief trips with a definite (and limited) purpose simplify the problem of handling a large class alone. Often, as is illustrated in the trips described, you can plan for work in groups.

All the trips suggested are appropriate for school-day use. None assume special habitats, such as ponds, brooks, or woodlands; instead, school grounds with some lawn, some plantings of trees or shrubs, some bare ground, some fencerows, and the sky overhead, provide suitable settings for many. Most are planned to contribute to science units presented in one or another of the generally used elementary science textbooks, five sets of which were consulted in a search for opportunities for effective use of outdoor teaching related to the content presented. Opportunities for outdoor teaching exist in all fields of science, but plant studies were chosen for special emphasis in this Leaflet.

Many brief suggestions rather than detailed plans for a few outdoor studies are given. To you is left the choice of those you can and wish to use; and in your capable hands is placed the responsibility to work out definite plans and to make your own applications to units under study and to generalizations you wish to develop.

There is no definite grade placement, although some trips are described as they were carried out by a specific grade group. Few teachers will use an activity exactly as it is suggested, but will vary it according to the materials available, to the

age, interests, and understandings of the group involved, and to the general aims of the study of which it is a part. Special emphasis has been placed on activities suited for kindergarten and elementary grades, but many of the suggestions could easily be modified for use at higher levels. Textbooks for the appropriate grade will help to determine grade placement as well as content.

It is hoped that these suggestions will help you to plan outdoor activities that will definitely enrich the "on-going" experiences of your group; that frequent excursions of this kind will help to build an appreciation of the out-of-doors as a useful laboratory; and that they will also make both you and your pupils increasingly aware of those too-good-to-miss opportunities for learning that must be seized as they appear, and which, as often as not, are the result of some child's chance discovery.

This chance discovery led a class to a well-hidden nest not 50 feet from their classroom door.

An Aerial View of Lansing Central School

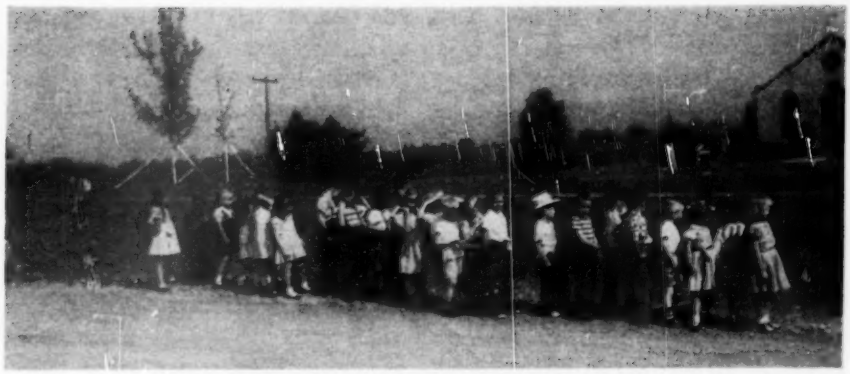
Through the Year with a Kindergarten Class

By DOREEN PERELLI

THE following field trips were taken by a kindergarten class at Lansing Central School. The teacher, the only adult on the trips, supervised from 32 to 37 children. All the trips were on school property and lasted from 5 to 15 minutes. Lansing Central School is fortunate to own a small tract of woodland as well as a large playing field. From the field there is a wide view across farm and woodland to Lake Cayuga.

Planning for Trips

Before the class made any trips, they discussed the way to behave. Much guidance by the teacher was needed because in the first weeks of school children are not accustomed to group discussions. Finally, the class decided that in the interest of safety no one should ever lose sight of the teacher or go where he could not readily hear instructions. The children were encouraged, however, to look for things of interest to show the class and not to stay so close to the group that individual observation was impossible. The class also decided that the teacher must be able to get the immediate attention of the group, not only in times of danger but also to show things of interest. They decided that the same call to attention that was used in the classroom would serve outside. These guides to behavior were discussed before each of the earlier field trips. Later in the year when their patterns of behavior were es-



A kindergarten practices walking along a road.

tablished, they needed no reminder of rules.

Practice Trips

1. On our first trip we walked across the field and looked at things the children found. We tried our rules and decided they were satisfactory.

2. Part of the school woodland is on the edge of a gorge. To use this area the children needed some special directions, so on the second field trip we visited this gorge. On the spot we discussed the dangers and agreed that no one should run in the area, for he might trip over a loose stone and fall into the gorge. For the same reason we decided to stay away from the edge of the steepest part. David threw a stone into the gorge, and we ruled out stone throwing, not because it was dangerous to anyone in the class, but because some one below might get hurt.

3. On the third trip we learned to walk along the edge of the road and to cross it, since to reach part of the school woods we had to travel a short distance along the State highway and cross a side road.

Fall Trips

1. On our first real trip we looked for fall flowers in the field. The first one the children found was a fleabane. We admired its beauty and mentioned its name. The second flower was goldenrod. William knew its name and Monica thought that golden was a good name for it. One child noticed the pollen and wanted to know what it was for. I told them that a grain of pollen joined with a tiny egg and made a seed.

2. On the next trip, we found a large Canada thistle. We looked at the flowers and saw that some had "turned to seeds." Naturally none of the children picked the flowers. When asked why they said, "It's prickly, of course." I asked them whether they thought this was of value to the plant. A child replied, "It helps the flowers not to get picked or anything." William said,

1. Bur Marigold; 2. Yellow Foxtail; 3. Fleabane; 4. Heal-all

"Then they can make more seeds."

3. We made several other trips to look at these and other flowers, including alfalfa, asters, and heal-all. Some of these trips were for review and several were just for fun. On the latter trips we did not look for anything particular, but just enjoyed the beauty of the outdoors.

4. On this trip we hunted on the field for things not easily seen. One child found a yellow fox-tail. Someone recognized it as a kind of grass. The children liked its furriness and all tried to find a sample. I asked them if anyone had ever seen an animal whose tail looked like that grass. With a little prompting they arrived at the name *fox-tail.* They were delighted with the name.

5. We stood in the middle of the field, where the view is widest. The children were looking for things that told them it was fall. Several of them noticed the change in the color of the leaves. Billy noticed that the corn was golden. I told them that some of the flowers, such as goldenrod and aster, bloomed only in the late summer and in fall. For the next few trips we stopped at this point to notice changes. We noticed that some trees turned red, some yellow, and others brown. We did not attempt to name the trees. Finally, one day a child pointed out the lake. Until that day we could not see it from that point because of the leaves on the trees.

6. We went along the edge of the field where many leaves had collected, and each child gathered as many different colored leaves as he could find. We took them inside and pinned them on the bulletin board. The children were amazed at the range in color and shapes. (*Note:* Some teachers, especially in the middle elementary grades, may wish to follow this activity by waxing choice specimens. Rub a moderately hot iron over a cake of paraffin, then

iron both sides of the leaves. The iron should be just warm enough to melt off a thin coating of paraffin. Waxing preserves the autumn color.)

7. Some of the children commented that the hemlocks at the edge of the field were still green. I asked them if they could think why. William replied, "Because they're Christmas trees." They looked more closely at the leaves and decided the needles were tougher than some other leaves and so could stand the hard winter weather. They could see also that snow would slip off such tiny leaves and "wouldn't make the tree too heavy."

8. Gradually, through our trips to see flowers and by indoor work, we built up the concept that seeds were "baby" plants and that to grow well they had to move away from the parent plant. The next few trips were designed to acquaint the class with methods of seed dispersal. I purposely took the group through an area thick with *Bidens* (beggar's ticks or bur marigold). Soon they were busy picking off the "hitch hikers!" Finally David said, "Why, it's a seed." (Note: Mrs. Perelli made no attempt to discriminate between seeds and seedlike fruits such as Bidens. The term *seed* in its general sense is considered adequate.) I led them to a burdock and gave them each a passenger to take back to school on their coats.

9. On this trip we found a milkweed with the pods just starting to open. One of the children opened a pod and we noticed the beautiful way in which the seeds were arranged. Then we let the seeds go and the children chased them.

10. On this trip we chased thistle and dandelion seeds. There was a good breeze and so we watched how far the seeds traveled.

11. We looked for seeds that animals would move by storing them for the winter. We found several acorns. The children liked the way the acorns fitted their cups so well.

Winter Trips

1. On this trip we looked for signs of winter. All the children at once commented that the leaves had fallen from the trees and that the lake was visible. Donna mentioned that the children had coats on. William noticed that the flowers had gone.

2. The next time we went for a walk it was snowing. The flakes were large and the crystal patterns were clear. The children caught them on their sleeves and were excited about their beauty.

3. We made snow balls and threw them at a pole. I asked the children to hold one ball in their hands. Of course the snow melted and showed them that snow is a form of water.

4. There was a light powder of snow on the ground. The children walked across the lawn and then looked back to see their tracks. They followed them back.

5. I walked in the snow beside a child. Then we examined the differences in the tracks. The class decided it was easy to tell where the

teacher went because her feet were bigger.

6. We developed the track idea further by comparing the difference in the patterns of the children's boots.

7. We jumped, walked, and ran in the snow and noticed how different the tracks were.

Trips 4, 5, 6, and 7 were in preparation for examing animal tracks. Unfortunately after that there was little tracking snow, so the children had no practical experience with tracks other than their own. Not many trips were taken during the winter, because many of the children were improperly clad.

8. One day after a snowfall there was an immediate thaw. We went to look for places where the snow still remained. We found it under trees, in gullies, and by the school. The children decided that snow stayed longest in shady places.

9. It was a sunny, windy day. We stood in the sun, in the shade, in the wind, and out of the wind. The children decided that it was coldest in the shade, where the wind was blowing. It was warmest in the sun, where the wind was not blowing.

10. We walked through the woods hoping to see some birds. The children were quiet, as we had discussed previously that noise frightens birds. We heard and saw several chickadees. The children loved their pert little caps and bibs, and were entranced by their acrobatics and their cheerful call.

Spring and Early Summer Trips

1. Some areas around the school were bare of grass and new seeds were planted. Footprints soon marked the newly-seeded ground. We went out to examine the area carefully and noticed that where people had walked the ground was hard-packed. The places where the

A Dandelion Hunt

Left to right: Black Birch (staminate or pollen-bearing catkins, marked s; pistillate or seed-producing catkins, marked p); May Apple; Coltsfoot

grass was growing were not so packed. We decided that little seeds couldn't grow in hard-packed soil or that if they did the young plants would soon be broken by heavy feet. Two days later one of the class forgot the new grass on his way to the bus. He was stopped not by the teacher but by an anguished cry from the other children.

2. We went to the woods, just to see what we could see. One of the children found a snail shell. Another child found a bigger one. That set all the class searching. Later they compared their loot as to size, shape, and color. "Teacher" was needed only to prevent one competition from being settled by fists instead of observation.

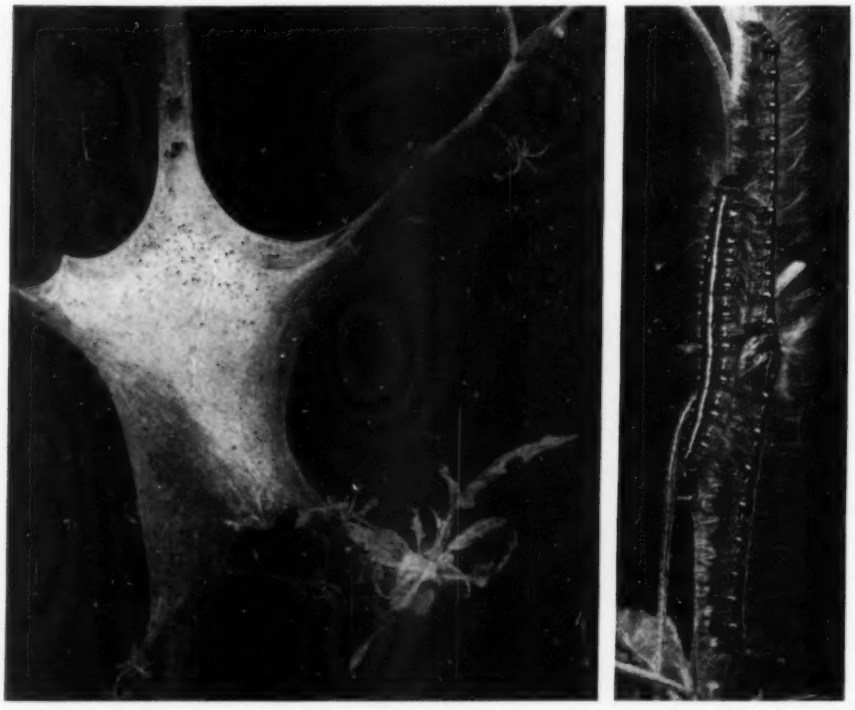
3. One day Jimmy came running in to say he had seen green buds on an ornamental shrub outside the school room. We all went out to look, and noticed the way the young leaves in the buds were packed. From then on the children inspected those buds every time we went to the playground. They watched their development without any further "teaching" or formal field trips. Many of our most rewarding trips have developed in this spontaneous way. I did not know the name of the plant – it did not matter.

4. Each child picked a dandelion head. Then I asked if they had a whole bouquet of flowers. Several of them stooped to pick more. I told them it wasn't necessary and that each one had a whole bouquet. They didn't believe me. I took a flower head apart and gave them one floret each. Without a word they examined their dandelions. Finally Billy said. "Yep, a whole bunch of them." (Note: Mrs. Perelli did not call attention to flower parts nor to details of structure. The children merely accepted the florets as

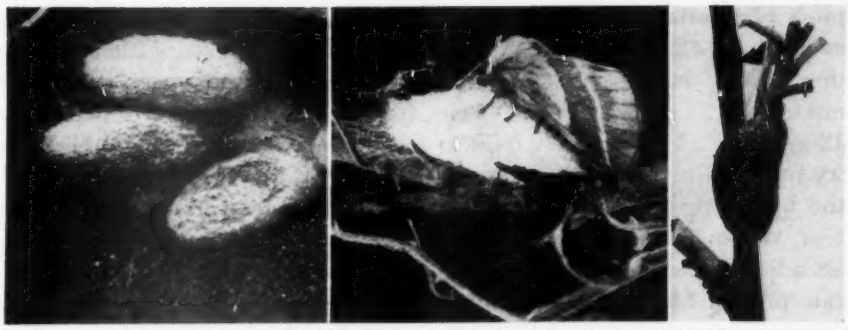
"little tiny flowers." For further discussion of Composites, see pages 51 and 52.)

5. We examined coltsfoot, another composite. All through the spring and early summer we examined flowers to see if they were composites. When the daisies bloomed, the class quickly saw that there were two kinds of flowers in a daisy head, "the 'ordinary' ones and the ones that carry the flags."

6. When the spring flowers came into bloom, the children were a little reckless with their picking; so we made some rules about picking. The children made most of them with a little help from me. The first rule was that we would not pick any flowers in the school woods since, with so many children visiting the area, there would soon be no flowers left. We decided not to pick flowers if we had also to pick all their 'food factories', the leaves. We decided that some flowers are stronger than others or "have more babies." We could pick these safely. Since it is hard to know which these are we would ask our teacher. Our last



Apple-tree Tent Caterpillars and Their "Tent."
Can you find the tent door?



Left to right: Cocoons of Apple-tree Tent Caterpillars; a Newly Emerged Moth on a Cocoon; an Egg-mass

rule was that we could pick as many dandelions as we liked – a safeguard.

7. The first woodland flower we saw was a small planting of February Daphne. The children were impressed by its beauty. I mentioned its name but made no point of their learning it. With all the spring flowers this was our policy. We were out primarily to enjoy their beauty, for that is their main value, but many names were learned also.

8. The children were interested in the hepatica's leaves. William thought it was such a sensible plant to keep its "food factories" ready all winter. They were thrilled with the little furry new leaves that developed later, after the blossoms had gone.

9. When asked if trees had flowers, most of the class said no. One child said that apple trees have flowers. We visited the woods again and saw the pussy willows with all their golden pollen. A child noticed the redness on the maples and asked whether the "red things" were flowers. We examined them and decided they were. On a later trip we looked at flowering-dogwood blossoms.

10. We stood on the playing field and looked across the valley. I asked the children how they knew that it was spring. They mentioned that the trees were turning green. Jimmy said "It may not be leaves though; it's probably flowers."

11. We walked across the field looking for things of interest. Jennifer noticed the catkins on the birch tree. Some children thought they were flowers and others thought they were seeds. Finally we decided they must be flowers, as we hadn't seen any flowers previously that could have made the seeds. This incident led to an interest in the other ornamental trees around the school. Ellen showed us "some Christmas decorations growing on a Christmas tree!" They were the young shoots, which were growing at the tip of every branch of a small

pine. The class examined them with as much care and enthusiasm as if they really had been Christmas ornaments.

12. We visited some cherry trees to see the opening buds and we found the beginning of a tent-caterpiilar tent. We found the old egg mass on an adjacent twig. We watched the caterpillars. Most of the children picked one up and several took one home with a supply of cherry leaves for food. We watched the site the rest of the year.

13. We went to look at May apples. The children were delighted with the little umbrellas and watched every day to see them open. On the way to see the May apples we heard a song sparrow. I told them that he sings, "Maid, maid, maid, put on the tea kettle-ettle-ettle". From then on every time we heard a song sparrow they would chorus, "There's the kettle-ettle bird." That day we also saw a phoebe. We watched it wag its tail. It became Mr. Tailwag.

14. We took a trip to the woods to find who lived under the stones. All the children found pill bugs. They loved to watch them curl up like pills and then stretch out and walk away.

15. We watched the flowers come out on the field and fade from the woods as summer advanced. The children were interested in the kinds of clover. I showed them that sweet clover was like the other clov-

New Growth on Pine—"Christmas Decorations Growing on a Christmas Tree"

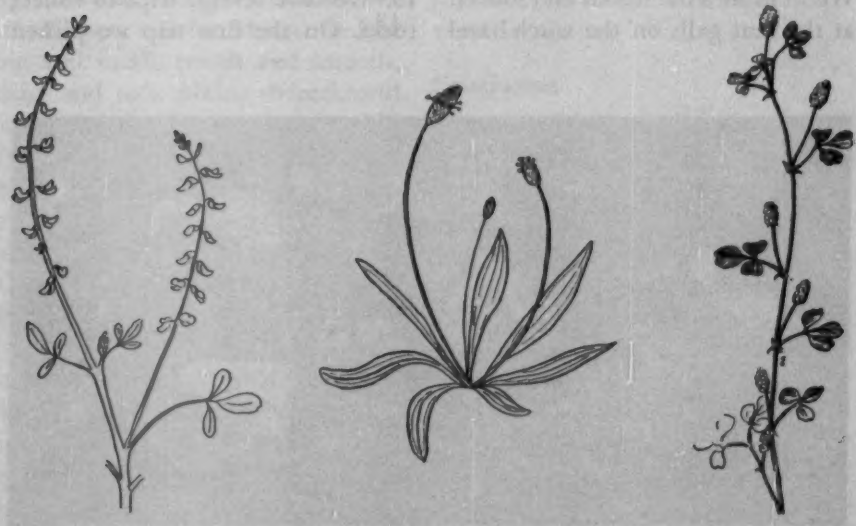
ers. One day Donna noticed some vetch. Looking at the flowers she said, "It looks like clover, too." They were pleased with the word legume which they could apply to all of them. Later they added black medic to their list of legumes, "because it looks just like tiny clovers."

16. When the narrow-leaved plantain bloomed, each child picked one blossom head. I told them that some of them were "tiny babies" and others were very old. We made a line starting with the youngest and ending with the oldest. The youngest were still buds. The next oldest had open flowers only at the bottom of the heads. The older ones were flowering at the tops of the heads and the very old had finished flowering.

17. While we were looking at sweet

This Sowbug looks much like a Pill Bug. Both are gray and about ½ inch long.

clover one day the children noticed the "spit" on the plants. Most of them shuddered away in horror. "What is it?" they wanted to know. I told them to look inside and find out. A few brave ones discovered the little spittle bug in the middle of the froth. Soon they were all looking for the bugs. We took some spittle bugs back to school to watch them make their houses.



Sweet Clover *Narrow-leaved Plantain* *Black Medic*

Sharon and her group examine a spittle bug.

18. I asked the children if they would like to see another insect "house". They were enthusiastic. We went into the woods and looked at the tent galls on the witch-hazel leaves. We noticed the little entrance into the "tent" on the underside of the leaf.

19. We took several trips to collect rocks. On the first trip we picked

The kindergarten found many kinds of clovers.

Witch-hazel Cone Gall, Made by Aphids
Look for the gall opening on the underside of the leaf.

up stones we thought we liked. We sorted them and found that we had big and small, rough and smooth, hard and soft, plain, striped, and mottled, red, pink, yellow, bluish-grey, grey, black, brown, and white stones. On the later trips we took empty egg boxes along and tried to find an example of each kind. The hero of the class was the girl who found the one green stone.

20. On the last trip of the year we looked out over the valley and decided how we knew that it was summer. We noticed the green leaves on the trees, the flowers in the grass, the birds flying about and singing, and we saw that our clothing was very different from that worn in winter.

Conclusion

During the year we took many trips beside these, but they were for review and covered much the same material. Most young children need to experience the same things several times before they can understand and remember. Probably few of the children will remember all of the facts they learned on these trips; but if some developed a natural interest in the outdoors and in living things, and learned to be a little more observant, the trips were well worth the time given to them.

Nature and Science Outdoors

By HELEN B. ROSS AND EVA L. GORDON

EACH of the five sections presented in the following pages begins with reports of several actual trips conducted in different seasons and with various grades. The remainder gives brief suggestions, the details of which most teachers will prefer to adapt to their own needs and opportunities. Some single-trip studies are outlined, as well as some that entail repeated visits.

The lists of activities described here are not exhaustive. They could not be – there is not room. A survey of the school ground and of the immediate neighborhood and an examination of the content of most units presented in elementary-school science will suggest many more. The Leaflet author will be pleased to receive reports of these or other schoolyard studies.

Plant Studies

Lawn Weeds. *Fall or Spring.* The third grade had been talking about plants and plant growth. One day they visited the school lawn. Each child found a lawn weed, then they sat in a circle and compared their weeds.

They found that most lawn weeds either grow in rosette form (with clusters of leaves that grow close to the ground) or they sprawl. They decided that plants cannot grow tall on lawns because the lawn mower cuts them off.

Photo by R. W. Curtis

Sugar Maple Blossoms

Trees and Shrubs in Spring. *Spring.* In early March white birch, silver maple, and forsythia branches were brought into the first-grade classroom and placed in containers of water. The children watched the leaves and flowers emerge from the buds. The silver maple, Forsythia, and white birch introduced the children to several concepts: (1) leaves, flowers, and branches come from buds; (2) tiny leaves, flowers, and branches are in the bud ready to emerge when conditions are favorable; (3) not all buds are alike, and not all of them contain similar tiny parts; (4) trees have flowers; (5) not all flowers have showy petals.

At another time, the children took apart buds of horse chestnut in the classroom. The miniature leaves, the insulating fuzz, and the sticky bud scales intrigued the first graders.

These two activities served as introductory experiences for the following outdoor experiences:

1. When buds outdoors began to open, the class went out on the school ground to see them. They reviewed the fact that buds might contain tiny twigs with leaves, or flowers, or both leaves and flowers. They noticed that buds with flowers were often larger than buds without flowers.

2. The children went outdoors to see how leaves were packed in different kinds of buds. The teacher selected the buds to be examined to prevent the destruction of terminal buds that control the shape of the tree or shrub. The children, working in groups, took the chosen buds apart, and then, using their hands for leaves, duplicated as closely as possible the "packing technique" (page 31).

3. As spring advanced additional trips were made on the school ground and to nearby street plantings to see different kinds of trees in bloom. Silver maple, Norway maple, sugar maple, horse chestnut, elm, and spruce could be seen without crossing any streets. The only flower with which the pupils had had previous experience was that of horse chestnut. They were surprised

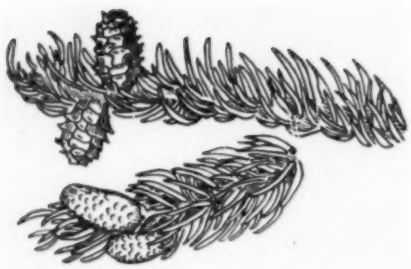
Photo by R. W. Curtis

Norway Maple Blossoms

by the size and beauty of the Norway maple flowers. They admired the daintiness of the sugar-maple blooms. But above all, they were delighted by the rosy hues of the pistillate spruce flowers. As one small girl put it, "It's a Christmas tree with Christmas decorations in the spring."

How Plants Grow. *Spring.* The first grade had taken soaked lima beans apart and had noticed the two "half-beans" and the "baby" plant with its true leaves and stalk inside the seed coat. (After 100 per cent destruction of soaked beans had followed the instruction "See what you can find inside your bean," the teacher learned to prepare her class to proceed carefully as they took apart their beans.)

During the following weeks the children germinated lima beans between blotting paper and the side of baby-food jars. They observed the splitting of the seed coat, the downward growth of the stalk, the development of roots, the emer-



Red Spruce
Above, seed-producing (pistillate) blossoms
Below, pollen-producing (staminate) blossoms

gence of the seed leaves, and the development of true leaves.

Then the day arrived when the schoolyard was full of germinating Norway maple seeds. The children went out to the yard and gathered fruits ("dried nose-pinchers," they called them) and opened them to look at the seeds. The children discovered that the seed coat could be easily removed and that the seed leaves were folded inside the coat. They soon found some seeds from which the stalk was emerging. With a little guidance, they noticed that the stalk always pointed downward.

They discovered other seeds that had taken root. In a more protected corner, the children found a little cluster of young trees. Here the seed leaves had expanded, and the true leaves were in evidence. In general pattern, the plant was "just like the lima beans."

The children enthusiastically gathered sprouting seeds to take indoors and plant in their terrarium so they could watch them more closely. One child picked up a sprouting acorn, which was added to the collection so they could see whether acorns grew like maple seeds and lima beans.

Seed Dispersal by Wind. *Spring.*

Maple Fruits and Leaves
1. Sugar Maple; 2. Box-elder; 3. Norway Maple; 4. Sycamore Maple; 5. Red Maple; 6. Silver Maple

A catalpa tree on the school lawn had scattered winged seeds liberally over the grounds. One spring day, the second grade went out to examine the seeds.

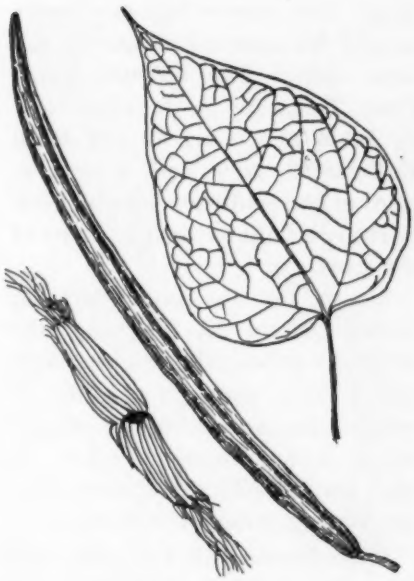
They noted the winged structure. They threw seeds up in the air and watched them drift to the ground. Then they dispersed to see how far from the parent tree they could find seeds. The group traveling eastward was stopped in their search by the highway more than 200 feet away. The group going in the opposite direction had no highway barrier but ran out of seeds about 100 feet away. The concentration of seeds on the eastern side was also much greater than it was to the west.

The children concluded that: (1) The wind helped the catalpa by scattering its seeds far from the tree. (2) The wind must have blown harder or oftener or both from the west this year in our town.

This last idea was incidentally introduced. The original object of the trip was to note wind dispersal of the seeds, but the activity might have been used in connection with a study of weather.

The catalpa was selected instead of Norway maple, elm or any other tree producing winged seeds or fruits because it was the only tree of its kind in the area and therefore seeds of catalpa found on the grounds were probably from that tree.

When Leaves Change Color. *Fall.* (See pages 52 to 54 of this Leaflet.)



Catalpa
Seed; fruit; leaf

Watch colors of leaves change from the time they are still green until they fall. Make a dated record of colors seen, including green. Observe small plants as well as trees and shrubs; many show color changes. Choose and mark certain plants to be observed through the season. Revisit them at intervals to note any changes.

As trees begin to color, observe what parts color first. What parts become brightest? Try to explain why. Watch for a tree or a shrub whose leaves change to: yellow only; red only; purple or plum color; orange; brown; a mixture of colors.

Collect leaves of different colors to be sorted indoors, according to color and, if desired, according to

shape. Can anyone find two leaves exactly the same color? Exactly the same shape? The bulletin *Know Your Trees* (by J. A. Cope and F. E. Winch, Cornell 4-H Club Bulletin 85, New York State College of Agriculture, Ithaca, New York) will help to identify many of the trees.

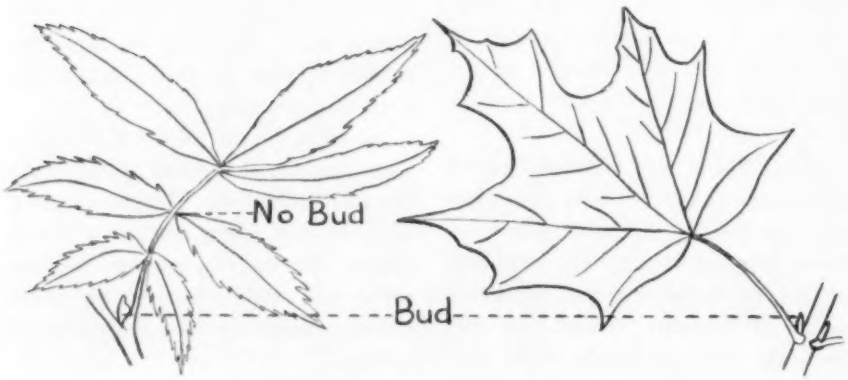
Search for the one leaf that shows each of the following: the brightest yellow; the brightest red; the greatest number of different colors; that it was partly shaded while it was changing color. (A wall covered with woodbine or Boston ivy is a good place to look.)

When Leaves Fall. *Fall.* (See pages 54 to 58 of this Leaflet.) At intervals visit trees and shrubs near the school to see the order in which they shed their leaves. When the first plant begins to drop its leaves, compare the ease with which a leaf can be detached from it and from a nearby plant that has not begun to shed, preferably one on which the leaves are at least partly green. Does any tree hold all or part of its leaves long after those of others have fallen? If so, what kind is it? Do all trees of the same kind shed their leaves at the same time?

Before most of the leaves are down, play "Hunt the Tree." Collect fallen leaves of a few kinds of woody plants. Name them if possible. Trace each to the kind of tree from which it came.

Take trips in different kinds of fall weather when leaves are falling abundantly. Collect specimens of kinds that are falling. Display them on the bulletin board, with a record of the weather. Do particular kinds of leaves usually fall abundantly in a special kind of weather?

If possible, find trees or shrubs that have compound leaves. Then watch them to see whether entire



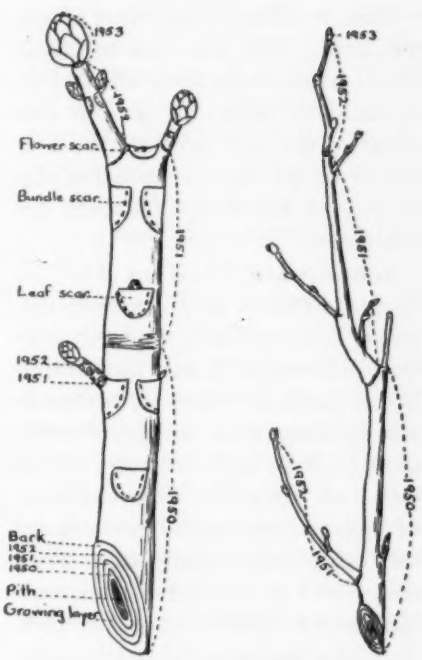
Compound and Simple Leaves

Both have buds where the stalk (petiole) joins the twig. There are no buds where the leaflets of a compound leaf are attached.

leaves fall in one piece or whether the leaflets fall separately. Do the leafstalks (petioles) of any remain after all the leaflets are gone? (Leaves such as sugar maple, which are "one piece," are called *simple* leaves. Leaves composed of several leaflets, such as hickory, are *compound*. The placing of buds helps to distinguish them, as shown in the illustration on page 26.)

Look at the scars left by falling leaves of various trees and shrubs. Each kind differs from other kinds, although sometimes it takes sharp eyes to see the differences. Note differences in size, shape, and arrangement (opposite, alternate, whorled). Note the bundle scars left where the connecting strands between the plant stem and the leaf veins were broken. Bundle scars differ in number and arrangement. Small children would profit from detaching a leaf and observing how its leafstalk fits the scar left on the tree. Trees such as ailanthus or horse chestnut that have large leaf scars and distinct bundle scars are best for beginning studies.

Observe buds of different kinds of woody plants, to emphasize their presence at this season. Note that they are placed above the leaf scars. Compare them as to size, color, shape, and arrangement. If sycamore is available, note that the hollow base of the leafstalk covers the bud. (Leave the study of bud development until spring, when the natural period of dormancy is at or nearing its end and bud growth can be forced easily.)



Twigs With Parts Named
Left: Horse Chestnut. Right: Basswood

Look for an evergreen, such as the white pine, that is shedding needles. The older needles, well back from the tips of the branches, brown and often drop in conspicuous numbers. Note beds of fallen needles where they have been allowed to accumulate. Suggest that children look up through the interior of a large conebearer, and report whether the inner parts are bare or needled; and on what parts of the tree the greatest numbers of needles grow.

Observe fallen leaves. Note where they collect. If a place can be found where leaves have been allowed to accumulate, note on a dry day whether the soil beneath them is dry or moist. Observe whether the lowermost leaves are partially decomposed.

Schoolyard Flowers. *Fall or Spring.* Observe and compare different flowers. Young children may note differences in size, form, number of parts, or color; variations in arrangement from solitary flowers, each with "a separate stem all its own," to flowers in different types of clusters. Don't omit the weeds and the other wild plants that sometimes find a place even on well-landscaped, well-cared-for grounds.

In the upper elementary grades, studies of flower parts and their function are usually included in texts or science outlines. Observe schoolyard plants to discover sepals, petals, pistils, and stamens. Do any flowers lack some of these parts? Cultivated flowers, particularly double ones, often offer problems in recognition of parts. Observe pollen – where it is borne and what happens to remove it from the flower. Composite flowers may be objects of special observation. (See pages 15, 51 and 52.)

First the Flower, Then the Fruit. *Fall or Spring.* Watch chosen flowers through the blossoming period and watch them as they fade and as the fruits develop. Children may need help with the concept that the part of a plant that contains the seed or seeds is the fruit, regardless of its nature. Fruits may be: *large or small; masses of separate small fruits,* such as a mulberry or a blackberry, or *simple fruits,* such as an apple or a pea pod; *fleshy fruits,* such as a peach or a tomato; or *dry fruits,* such as a milkweed pod or a maple key. Some dry fruits, such as bean pods and poppy capsules, open when they are ripe; others, among them acorns and sunflowers, do not. Even such small structures as a grass "seed" or a dandelion "seed" are truly fruits; but elementary-school children and their teachers may safely call them seeds, a term, which in its general sense, includes them as well as true seeds.

Tree Flowers. *Spring.* Every tree has some kind of flower. Some have two kinds: one that bears pollen but never seeds and one that lacks pollen but has seed-producing parts. In some that have two kinds of flowers, both grow on the same tree; in others only one kind grows on an individual tree. Study the flowers on the schoolyard trees.

Fruits and Seeds May Hitch-hike. *Fall.* Let children walk through a patch of roadside weeds. Instruct them not to remove burs and stick-tights. Return to the classroom, give each child a sheet of newspaper or a paper bag, and have him empty pant cuffs, shoes, socks, and other clothing. See how many kinds of seeds and fruits hitch-hiked.

Some Weeds Have Many Seeds. *Fall.* Find a large many-seeded weed that has not yet shed its seeds. Let

each child place a piece of the seed-bearing part in a paper bag. In the classroom, count the seeds or fruits from a single plant and compute the total. Pigweed, Queen Anne's lace, dock, burdock, or any one of the mustards are good choices, but the kind of plant is not important.

Plants Differ. *Fall or Spring.* A survey trip around the school will contribute in various ways to the concept that plants differ. Small children may be interested in size differences or variations in form or color of parts. Older children can discover such differences as: green plants that can make their own food and non-green plants, such as fungi, that cannot do so; plants that flower and produce seeds and flowerless plants, such as ferns, mosses, and fungi, that do not have seeds; annual, biennial, and perennial plants; woody plants, and those that die at least to the ground in the fall—a group commonly called *herbaceous* plants; differences in the growth of plants of the same kind in the open and under trees or shrubs, and where mowed and unmowed.

Climbing Plants. *Fall, or Any Season.* Some plants, such as sweet peas, climb by means of tendrils. Some are twiners. The leafstalks (petioles) of some coil around supports and thus help the plant to climb. English ivy puts out little roots along the stem that help to hold it up; so does poison ivy when it climbs. Boston ivy and some others cling by adhesive disks at the ends of rootlike tendrils. Climbing roses belong to a group that weaves

European Nightshade
This common vinelike plant frequently shows well how flowers come from buds, and fruits from flowers.

in and out of fences or trellises or among the branches of other plants. How many types of climbers can be found on the school ground? A helpful reference is *Play with Vines,* 63 pages, by Millicent E. Selsam (published by Morrow, 1951).

Deciduous or Evergreen? *Winter.* Make a survey trip to locate deciduous and evergreen trees, shrubs, and vines. Identify plants as desired. See page 55 of this Leaflet. (Many of the woody plants of school grounds are not native plants, but horticultural species and varieties. Nurserymen, florists, or homeowners with a special interest in landscaping are good sources of help in identification.)

Roots Differ. *Fall or Spring.* Dig up different kinds of plants. Wash off the soil. Compare the roots. Put together those that have one main root, such as a carrot; those that have many small roots, such as grass; roots that contain much stored food; and other groups that will suggest themselves as studies of roots and their functions progress.

Dandelions Are Worth Studying. *Spring or Fall.* Let the children search individually for "a specimen of dandelion." For studies with small children, leaves or leaves and roots may be specified at one time; buds and open blossoms at another; and fruiting heads ("old" dandelion blossoms) on a third trip. Older children working in groups may combine the three phases of the study in one trip. At least some of the following understandings can be developed.

Some dandelions grow in flat rosettes, others hold their leaves more or less upright. The rosettes are usually found where the dandelion had plenty of room to grow or on a lawn that is kept mowed. Plants with upright leaves often grow among tall grasses or in small spaces. Find a rosette. Lift the leaves. Do other plants grow underneath? Is the ground bare under the largest rosette that can be found?

Dandelions have tough, milky-juiced roots that often grow far into the ground.

Dandelion leaves differ in shape and size. They have milky juice. The cut end of the main vein of a fresh leaf, pressed lightly on paper, leaves shiny triangular prints that darken as they dry. Washed leaves may be tasted, and their use as greens discussed.

Enclosing a dandelion bud are two rows of green leaflike parts, called *bracts.* The outer, shorter row curls back over the end of the blossom stalk, the bracts of the inner row are long enough to cover the unopened flowers. Together, these rows of bracts form the *involucre.*

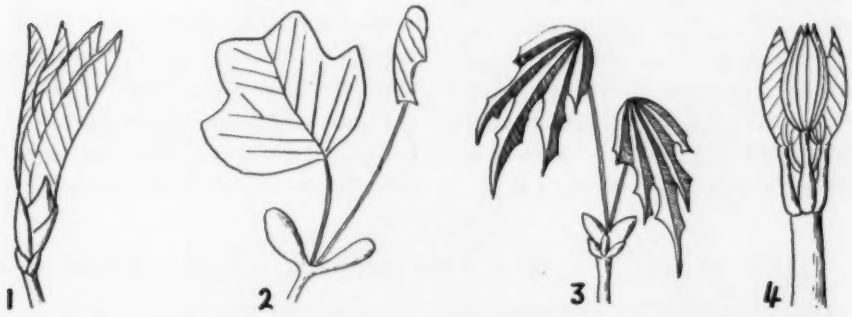
A dandelion head is made up of many small separate flowers, all attached to a pad-like place, called the *receptacle.* The small flowers may be separated, examined, and perhaps counted. Flowers such as dandelions are called *composites.* (See pages 51 and 52.)

Fruits develop from flowers. Have the children arrange themselves in order of the age of their specimen of "old" dandelion blossom. Then point out the transition from flower to fruit. Note that during this period, the flower heads are again enclosed by the involucre. In mature fruiting heads note the small, separate fruits, each with its "parachute" and heavier seed-bearing end. A lusty puff will demonstrate seed dispersal by wind and children can note again the bare receptacle and the involucre.

Dandelion flower- and fruit stalks differ in length depending on where they grew. Children may note the shortest and the longest, and compare the kinds of places in which they grew.

Note: Probably you should know, but not necessarily point out to your class, that dandelion flowers have a special provision for cross-pollination by insects; that they may be self-pollinated; but that most of the seeds probably are produced without fertilization by pollen.

Diary of a Tree. *Spring.* This can be a class project or individuals or groups may choose different trees or shrubs. Look for swelling buds, then find answers to such questions as these: Do flower buds or leaf buds open first? Do both flowers and leaves come from the same bud? What happens to the bud scales that covered the buds all winter? What are the flowers like? How fast do the leaves grow? (Mark three or four in different parts of the plant and measure them at intervals.) Watch for new growth at the ends of the branches. Discover what you can about insect and other animal visitors. What do they seem to do? Do they find homes, or food, or shelter? Branches may be cut in late winter and brought into bloom indoors, as a preparation for this study. A mimeographed bulletin, *Forcing Twigs,* is available from the



1. Shadbush; 2. Tulip Tree; 3. A Maple; 4. Horse Chestnut
These young leaves still show how they were packed in the winter buds.

Cornell Rural School Leaflet Office, Cornell University, Ithaca, New York.

Tree Injuries Often Heal. *Any Season.* Following a discussion of how our bodies heal injuries, go outside and try to find on the school ground trees or shrubs that show healed injuries.

Tree Rings Show Yearly Growth. *Any Season.* Study the end of a cut-off tree branch to find the annual rings. Count them. Their number is a good indication of the age of the branch. If possible, count the annual rings on a tree stump. About how old was the tree when it was cut?

Some Woody Plants Can Be Recognized by Their Bark. *Any Season.* Observe how the bark of schoolyard trees and shrubs differs. White birch and sycamore have almost unmistakable bark; that of some other plants is more difficult to distinguish, but differences can be found in color, in smoothness, in type of ridges, and in various other characteristics. Trees already identified would be good starting points. Bark from fallen trees may be collected, but as Marie E. Gaudette says in *Leader's Nature Guide,* "...it is not good conservation to take bark from living trees. Like taking a piece of a friend's skin."

Plants Live in Different Kinds of Places. *Fall or Spring.* Studies of plant habitats are frequently outlined for fourth, fifth, and sixth grades. Compare schoolyard plants that grow in such different locations as dry places and wet places; sunny places and shady places; rich soil and poor soil.

Plants and Frost. *Fall.* Make frequent surveys after the first frosts to note non-woody plants that have been killed by freezing. Can the children find plants that the frost does not kill? Or green leaves that frost does not harm? They may want to keep a "frost calendar" such as that suggested below.

Green Plants in Winter. *Winter.* Some time in December, January, or February when a thaw has removed most of the snow, look for green plants near the foundation of the building or in sheltered spots under trees or near fences. How many kinds can be found? How many are rosettes of leaves that lie close to the ground? Many kinds of weeds and some garden flowers winter as rosettes. This is true of many biennials, those plants that require two growing seasons to mature and produce seeds.

Plants and Light. *Spring or Fall.* Green plants need light, but some need more or less than others. Ob-

Date of frost	*Plants That Survived*	*Plants Killed*

serve (1) plants that grow in open, sunny places; (2) plants that grow where there is much shade; (3) plants that grow in either sun or shade. Does a particular kind of plant in the third group grow differently in a sunny place and in a shady place?

Note how leaves are arranged to get sunlight. In some plants the leaves are in rosettes; in some the leafstalks differ in length, forming a mosaic arrangement. Look for other ways leaves are exposed to sunlight.

Cover a small plot of grass with a board, a piece of heavy paper, or some similar covering. How long does it take the grass to turn yellow? How long is it before a healthy green color returns when the cover is removed?

Animals and Their Ways

Ants and Aphids. *Fall or Spring.* Some one left a lunch bag in the cloak room and ants moved in! At first the only reaction was one of annoyance. But after an ant cup was installed and the children watched the ants feeding from the cup and then feeding each other, interest took a new turn.

References on ants were provided. Soon it became evident that there are many kinds of ants in the world and quite a number of interesting kinds in the immediate area.

Aphids like these are found on many kinds of plants.

A rock in the corner of the school ground sheltered an ant colony, so a field trip was planned. On the way to the rock, the children noted small ant hills along the path and watched several scurrying small ants as they approached the hills. Some of these ants carried food.

When the children overturned the rock in the corner, larger ants than they had seen hurried in all directions. Some rushed to the piles of rice-shaped and nearly rice-size cocoons and began to carry them away in their jaws. No worm-like ant larvae nor tiny sugar-grain-sized ant eggs could be seen on the surface of the soil. When, however, the children opened the lower chambers of the nest with a trowel, they found ants in all stages of development.

Later in the week one of the girls arrived in the classroom greatly excited. She had been watching ants walking up and down the young oak tree at the street corner and had suddenly discovered that they were "milking their cows." The whole class went to see the ants feeding on the honey dew secreted by the aphids, about which they had read, but which many had never seen.

Ant Lions at Work. *Fall or Spring.* One day as the fourth-grade teacher was walking home from school, a neighbor near the school asked her to come and see some queer pits in the sandy soil at the side of the garage. As she examined

From Department of Entomology

Ant Lion Pits

the small inverted pyramids, she realized that they were made by doodle bugs, or ant lions. She had read about ant lions, but had never before seen them. Excitedly she asked whether she could bring her class for a visit and was granted permission.

The next day was bright and sunny. The class set out to watch the ant lions at work. They carried with them, in a jar, some ants which had been collected under a rock. In small groups the children gathered around individual ant lion pits and dropped ants onto the upper edge of the pit. They watched as the ants slipped into the waiting jaws of the ant lions. They dug up some of the ant lions and watched them shovel their way back to concealment.

Spiders. *Fall or Spring.* One day Marvin arrived in school with a wolf spider in a jar. As the children clustered around him, it was obvious that several of them were afraid of spiders and that no one knew much about them.

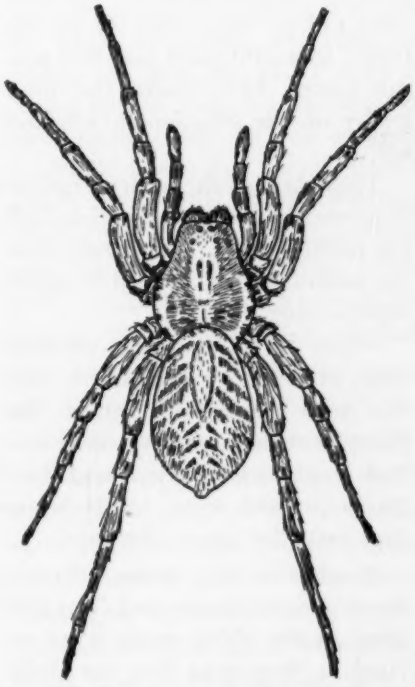
The teacher suggested that they learn something about spiders so that they could make their classroom visitor comfortable.

Spiders, by Bertha Morris Parker, was placed on the library table. As the children amassed information from this book, from science textbooks, and from a children's encyclopedia, they observed their captive and noted its eyes, legs, jaws, and method of travel. They learned that wolf spiders do not spin webs.

The teacher took the class outside to explore the window sills on the basement floor. There they observed three types of spider webs. By touching the strands of silk with a small stick they were able to discover which were the dry threads that were the framework of the web and made the runways for the spider and which were the sticky threads used to catch the spider's prey.

In several instances they located the spider's hiding place. In one web they discovered a spider neatly wrapping a protesting fly in a band of silk that soon made it helpless.

Food for Winter Birds. *Fall or*



Wolf spiders do not make webs

Winter. At the onset of winter the second grade discussed the problems that beset those birds which stay with us through the snowy months.

They listed the foods birds ate in summer. Then they decided where birds could obtain these foods in winter.

They took a walk along the road to look at the seeds and fruits on weed plants. They noticed the height of weeds, and decided that snow would cover many of them.

They made two types of feeders: one for seeds and one for suet and peanut butter. A trip to the school grounds followed to find the best places to put feeders.

A clump of evergreens where the birds would have shelter when they came to feed was chosen for the log feeder that contained suet and peanut butter. They placed the other feeder on the schoolroom windowsill.

They checked the feeders regularly to see what was eaten and to look for feeding birds. They found that the peanut butter needed frequent replenishing.

When it snowed, the children went outdoors to find weeds they had seen before and found that many of them were covered as they had predicted. They found bird tracks around some weeds whose tops extended above the snow.

Tracks in the Snow. *Winter.* Snow covered the ground. The children in the third grade were excited as they came into the building. Some of them had been playing snow tag.

They decided to go out to look at tracks. They found two sets of dog tracks where a Cocker Spaniel and a Boxer had crossed the school grounds.

They examined dog tracks, child tracks, and teacher tracks. With guidance, the children discovered that they could tell:

What kind of animal made the track.

About how big the animal was.

Which way it was going.

How fast it was moving.

When it stopped to explore something.

They decided to look for other tracks on the way home from school to see whether they could read their story.

Earthworms. *Spring.* Spring had come. The second grade had been making a list of signs of spring. One day the teacher suggested they go out to look at a new sign of spring.

She led the children to a spot on the school grounds where there were many small piles of soil, each surrounding a little hole. Some of the boys identified them as earthworm tunnels.

The children poured water on the ground and watched it run down into the tunnels. They poured water on another section of ground where there were no tunnels. They noticed the run-off in this area.

They crushed some of the earthworm deposits in their fingers and noted how easily the soil broke up.

They decided that earthworms were useful in several ways and that they were a good sign of spring.

Birds' Nests. *Winter.* A trip around the school ground should locate some birds' nests in shrubbery and trees, or on the building. Why is it so much easier to locate nests now than in the early fall?

Where Are the Insects? *Late Fall or Winter.* Look under loose bark, under logs, boards or stones, in weeds and shrubbery for eggs, pupae (including cocoons), and hibernating larvae and adults (A mimeographed bulletin, *Insects in Winter,* is available to teachers, from the Cornell Rural School Leaflet Office, Cornell University, Ithaca, New York.)

Animal Tracks in Mud. *Spring or Fall.* Often an almost dry mud puddle is an excellent source of animal tracks. Birds, mice, chipmunks, and squirrels commonly come to drink and leave a record of their visit in the soft mud. Look for such puddles.

Schoolyard Animals. *Any season.* Search among plants, in soil, under boards or stones, in cracks and crevices about the building, in water, and in other places for animals of all kinds. You may need to help some of the small children to include among the animals they see such creatures as insects, snails, and sometimes, even birds or themselves. Watch any animals that are found. Try to discover what they are doing. Do any have homes? Later trips may be devoted to observations of particular kinds of animals, or to studies such as those outlined in the following paragraphs. Textbooks and reference books suggest many others.

1. *Ways of Moving.* Some animals run, some fly, some crawl. How many ways of moving can the children discover? Do four-legged animals, such as dogs and cats, move one leg at a time, or two, or more? Do they ever have all four feet off the ground at the same time? In how many of the ways observed can children move?

2. *Seasonal Activities.* Note differences in what schoolyard animals do in different seasons.

3. *Food and Ways of Eating and Drinking.* Animals that eat plants or parts of plants probably are easiest to find on most school grounds, but some animal-eaters may be observed, as well as some creatures whose diet includes both plant and animal matter. Feeding insects are likely to be discovered most frequently, but spiders, birds, and occasional mammals may be observed. Watch what kind of food each animal eats, and what parts of its body it uses to help it eat. Look for interesting ways of eating.

Many insects suck plant juice or sap. Aphids or plant lice are common examples and are found on many kinds of plants. They sometimes give off excess food in the form of a liquid called *honeydew,* which may be so abundant that it forms a glistening coat on nearby

leaves and branches, and may even drip down on objects below. Ants are fond of honeydew, and often may be seen lapping it up, or even stroking aphids with their antennae or feelers, thereby causing them to give off a new supply.

To watch a butterfly or a moth uncoil its long sucking tube, gather nectar from a flower, and then coil its useful "tool" below its head is an unforgettable experience.

Other insects have chewing mouthparts. Children often are fascinated to see that the "jaws" of such insects, when working, move sidewise instead of up and down as do their own.

4. *Colors and Color Patterns.* Try to find and list some colors or color patterns that make their owners conspicuous, and some that make them difficult to see when they are in their usual places.

5. *Keen Senses.* Ability to see, hear, smell, and otherwise sense danger or difficulty or locate things they need helps many animals to survive. Watch for indications of such abilities. For example, moving ears might show hearing.

6. *Animal Sounds.* Try to see how they are made.

7. *Young Animals.* Look for young animals. Do their parents take care of them? How? How long? Do they look like their parents? Some change in appearance as they grow. Watch such changes as you can. Find young animals in various stages of growth.

Earth Studies

Little Rivers. *Fall or Spring.* It had been raining hard. Suddenly the rain stopped. The fifth grade hurried outside to study the "little rivers" of the playground. They had read about tributaries, deltas, water falls, rapids and lakes. They had talked about them and seen pictures of them – but now they were going to see them in miniature.

It was only a minute's walk to the path where the water flowed. In a few minutes they were back in their seats. But in the meantime they had gained a clearer picture of inland waterways. Geography and earth science terms had gained meanings.

A slightly sloping, newly graded lawn often shows a similar drainage system with a main stream and tributaries.

Soil Erosion. *Any Season.* After the sixth grade had spent some time studying water and soil erosion, the teacher suggested that they go outside to observe the action of water on various areas near the school.

Across the street from the school a dirt road slopes down through grassed areas. Above the road an even steeper area is covered by trees. Erosion is marked on the road. The other areas are uneroded.

The children compared the three areas and noted how cover slows water and holds soil and water.

Several days later they examined a patch of school lawn that was

badly eroded. They compared it with an area on the other side of a nearby walk that was not eroded. They decided that: (1) both areas sloped; (2) the eroded area had many trees, the other area did not; (3) children used the eroded area for a short cut.

Someone commented that the steep slope across the street from the school, which they had examined earlier, was not eroded, and it was covered with trees. They added another idea to their list: The janitor rakes up the leaves under the trees in the eroded area.

Then the question was posed, "Can we do anything about the erosion?" They decided that the janitor had to rake up leaves; that children in the school could help to prevent further erosion by using the nearby walk; that there was too much shade for grass, and that they needed some plant that would grow in shade and hold the soil. Since they did not know of any plant that would meet this requirement they appointed a committee to consult "an expert." The "expert" recommended Periwinkle, *Vinca minor,* which was easily obtained in the area.

Before the school term ended, the children had planted a test area of Periwinkle which gave every evidence of flourishing.

Running Water Carries Soil. *Spring or Fall.* A large mud puddle on the schoolground made an excellent place for the sixth grade to study delta formation. During a rain the children watched little streams of water flow into the puddle and noted the muddiness of the water.

Several days later when the water in the puddle had evaporated, the class went out to look at the "lake bottom." They noted the deltas extending into the puddle where the little streams had entered. Close examination of the deltas revealed that the coarser materials had been dropped at the "lake" edge and the finer particles deposited toward the center. They noted also the fine deposit of silt all over the bottom of the "lake," material that had settled out of the muddy water as it stood in the puddle. They tried to trace the course of the little streams to see where the soil had come from.

When they returned to the schoolroom, the teacher was satisfied that they understood better the two processes of erosion and deposition.

Soil Carried by Water May Do Harm Where It Is Deposited. *Spring or Fall.* The sixth grade had been studying soil conservation. They had talked about the effect of running water on bare slopes. One day after a rain they went out on the school ground to a spot where a level grassy area lay at the base of a bare slope, and was bordered on its other side by a walk. The children observed the gullies on the bare slope. On the grass below they found a heavy deposit of soil which had been washed from the slope. They

noted that in spots the grass was almost covered with coarse soil materials. Beyond the grass the water ran over the walk. Water collected in a depression at a corner of the walk. In this area the children observed a heavy deposit of fine silt.

With teacher guidance they concluded that: (1) Not only did uncovered slopes suffer when erosion took place, but crops on level land below them might be destroyed; (2) much of the finest material is deposited eventually in streams and lakes where it may cause damage instead of doing good; (3) in the city, fine soil may be deposited on walks and in sewers where its removal costs taxpayers money.

Plants Help to Hold Soil. *Spring or Fall.* After a discussion of the role of cover in holding soil, the fifth grade was taken to an embankment at the edge of the school ground to make some simple measurements. Half of the embankment had a good grass cover; the other half was bare.

Under the teacher's direction, the children dug small paired holes in several spots at the top and at the bottom of the slope, and measured the thickness of the topsoil. They discovered that the depth of the topsoil on the well-sodded area was approximately the same at the top and bottom of the slope. They obtained different results along the bare area. At one place the topsoil at the top of the slope was very thin, but that at the bottom was thick. At another point where the slope was steeper, there was no topsoil on the upper portion of the slope and at first glance there seemed to be none at the bottom. Digging, however, revealed a thick deposit of topsoil buried beneath subsoil and rock debris carried down from the denuded upper area.

The children concluded that the grass slowed down the water and held the soil in place; that uncovered hills lost their valuable topsoil; and that if erosion on upper slopes proceeded too far, the valuable soils of the lowlands might be buried and made inaccessible.

Sunshine and Shadows. *Winter or Any Season.* Some sunny day when fresh snow covers the school lawn let children, working in twos, compare the length and direction of shadows at nine o'clock in the morning, at noon, and about three o'clock in the afternoon. One child of each pair stands in a place that will be in sunshine all day. He stands quietly while his partner walks carefully around the edge of his shadow. When the time comes for the next observation, the first child returns to the footprints he made earlier; the second child again outlines the shadow by walking around its edge. Can the children predict about where the third shadow will fall? When there is no snow, pegs or small pieces of cardboard can be used to outline the shadows.

The Cornell Rural School Leaflets, *Lawn Laboratories* (Fall 1948) and *Sky Laboratories* (Winter 1952–

53) outline many simple schoolyard studies of the changing patterns of sunlight and shadow through a day and with the seasons. These Leaflets and others also suggest many additional outdoor activities. The Winter 1953–54 Leaflet, *Air Laboratories,* will emphasize weather and climate studies.

Grass Holds Water. *Spring or Fall.* Pour 1 quart of water on grass, and 1 quart on a bare path. Notice how the blades of grass hold the water and permit it to sink into the ground. Compare this with the way the water spreads out and runs on the path.

Soil Profile. *Any Season.* Older groups can profitably study differences in thickness of topsoil and subsoil, as described in *Conservation, A Handbook for Teachers,* Cornell Rural School Leaflet, September 1951, page 42. (This Leaflet outlines many other good schoolyard studies.)

Warm or Cool? *A Sunny Day, Any Season.* Let members of the class place their hands on various surfaces, and compare the warmth of such things as grass, soil, a path, a concrete walk, car bodies, glass, and other objects. Compare like objects, one in the sun and one in the shade. Children may stand in a shady place for five minutes, then move to a nearby sunny spot for the same length of time. Children able to read thermometers may check results.

Wind Blows Soil. *Any Season.* On a windy day, observe soil particles and other materials carried by the wind. If possible discover where some of the materials came from, where they settled, and why they settled where they did.

Daytime Moon. *Any Season.* From a calendar or almanac determine when the moon is in the first quarter; then look for it in the eastern sky during the afternoon hours – it rises in the east about noon and is about overhead at sunset. Compare the light of the moon with that of the sun. Repeat observations at intervals during the afternoon, and from day to day as the moon grows toward a full moon. Help the children to recognize that at first quarter the moon and the sun are "half-the-sky" (about a 90-degree arc); that at full moon the moon rises as the sun sets; and that the moon is visible only because the sun shines on it. When the moon is in the last quarter (it rises about midnight and sets about noon), children may observe it in the western sky during the morning.

Experiences with Matter and Energy

Fire Safety. *Any Season.* Fire-prevention week was being celebrated in the city schools. The sixth-grade teacher decided that the best way to prevent fires was to gain some knowledge of fire.

He discussed with his class the requirements for fire – fuel, a way to heat the fuel to its kindling point, and air. They studied the fire regulations for the city, obtained a permit to build a fire on the playground, and posted the permit on the bulletin board.

The group went out with fire-building materials they had previously collected – plenty of dead hemlock and pine twigs, fine pieces of wood, and "logs" up to an inch in diameter. They took with them a bucket of water and a shovel. They selected the pitcher's box on the baseball field as the site of their fire because the soil there was hard packed and free from vegetable materials.

They laid and lighted the fire under the teacher's supervision, and discussed the advantage of a small fire for both cooking and safety.

They put out the fire by splashing water on the logs, and removed all evidence of the fire.

Flight Studies. *Fall.* The sixth grade had been studying flight. They had talked about airplanes, gliders, and parachutes.

One day they took a trip to gather the seed-like fruits of ash, maple, ailanthus, and dandelion as well as milkweed seeds.

The children compared them to propellers, airplane wings, gliders, and parachutes. They tossed them up in the air and watched them make their way to the ground. They noticed that the heavy seed-bearing end landed first.

They decided that the laws of flight were in operation long before man learned to fly; and that plant flight was an efficient way of distributing and planting seeds.

Levers in Action. *Any Season.* A large rock at one corner of the school ground served as a fulcrum

Some Tree Fruits
1. Red Maple; 3. Box-elder; 5. Basswood;
2. White Ash; 4. Sugar Maple; 6. Ailanthus

from which to launch a unit on simple machines. One afternoon, the fifth grade went to the rock and were asked to move it. With the united effort of several children, the rock could be shoved to one side but its shape made it unwieldy.

Then a crowbar was introduced and one boy immediately suggested that they get a smaller stone to rest it on. Then they inserted the crowbar beneath the rock. The rock could be moved by one child pushing downward.

The teacher asked whether the second rock was necessary. After some discussion another child volunteered to move the rock without a stone on which to rest the crowbar. He slipped the bar under the rock and pushed upwards – the rock moved.

With some guidance, the children noted that both times the crowbar was resting on something but that the resting point was different in the two instances.

On returning to the classroom, each child got out his ruler and several books and tried the two methods of using a lever that had been tried on the playground.

They noted the advantage of being able to push downward in the first type of lever; and the greater ease of moving an object with the second type. By changing the resting point and moving the weight, they discovered the advantage of having the long part of the lever between the resting point and the force they were exerting.

Wheels and Axles. *Any Season.* After the sixth grade had talked about the wheel and axle they set out to see how many wheel and axles they could find in use in fifteen minutes.

They opened the door – with a wheel and axle doorknob; noted that the key in the lock was also a modified wheel and axle; and that the pencil sharpener on the door frame operated because of a wheel and axle. In the hall they passed the janitor pushing a mop bucket mounted on wheels. On the school grounds, they stopped to count the wheel and axles on Jack's bike and to note the wheels and the steering wheel on the principal's car.

Across the street they noted a wheelbarrow being pushed into a garden and a small child playing on a scooter. They returned to the schoolroom by way of the basement. There they found another wheel and axle – the steam valve with which the janitor controlled heat. They noted the valve on the faucet at the drinking fountain and Jim's roller skates in the cloakroom.

As they returned to the classroom, fourteen minutes later, Mary remarked that a number of them had been carrying several wheel and axles on their wrists and that one of them, the winding stem, was very obvious.

Simple Machines. *Any Season.* The sixth-grade class had been discussing simple machines and had learned that many machines are modifications of basic simple ma-

chines (the lever, the pulley, the wheel and axle, the inclined plane, the wedge and screw, the piston and cylinder.) They went down the street to a building under construction.

There they saw wheelbarrows (lever and wheel and axle) being pushed up inclined planes, cranes (pulleys and levers) lifting heavy beams, block and tackles being used to raise materials. Hammers (levers), riveters, and air drills (piston and cylinder) were in use. Hand trucks delivered material within the framework of the new construction and gasoline-powered trucks delivered materials from the outside.

They concluded that some machines were really simple machines in themselves and others were complicated combinations of simple machines. They also decided that the world would be quite a different kind of place had man not learned to use simple machines.

How Things Move or Are Moved. *Any Season.* "Nothing moves unless something pulls or pushes it." *(Discovering Our World,* Book 2, page 45). The children should try to discover what force moves each thing they see moving.

Wheels Help to Move Things. *Any Season.* Children may fill a small wooden box with stones, attach a strong string to the box, and then try to pull the load up a short slope. Provide rollers – cylindrical sticks from construction sets, pieces of doweling, or round pencils – to put under the box. Is it easier to pull it up the slope? Wheels of spools may be attached with nails so that the spools turn. Is it still easier to move the load?

A Simple Illustration of Jet Propulsion. *Any Season.* Let the pupils, in groups or as individuals, inflate small balloons, then close off the openings, thereby confining a gas in a space under pressure. The inflated balloons should be held closed by pinching each back of the opening. Held high and released, the balloons will fly erratically but rapidly. Do they fly in the direction of the escaping air or in the opposite direction?

What Sounds Can You Hear? *Any Season.* Have children sit or stand on the lawn for a minute or two with their eyes closed. Then ask them to report and list all the sounds they could identify. These might include wind, a passing truck, a robin's song, a squirrel's chatter, a neighborhood dog, running water, a fire siren. How do sounds differ?

Sound Travels Through Metals. *Any Season.* If a wire fence is nearby, the children, working in pairs, can discover that metals conduct sound better than does air. One child puts his ear close to the wire. His partner taps the wire lightly a few feet away. After a moment, the tapping is repeated, but this time the listener does not put his ear close to the fence. As the two children move farther from each other, they may reach a distance where the listener can hear the tapping only when his ear is close to the wire.

Things Indians Used. *Any Season.* At the conclusion of a unit on Indians, the sixth grade went to see what things they could find on the school ground that were used by Eastern Indians. They found:-

1. Basswood, used for cordage
2. White ash, for bows
3. Quartz, for arrow heads
4. Sugar maple, for sugar and sirup
5. Viburnum, for arrow shafts
6. Spruce gum, for chewing
7. Spruce cones, for firebuilding
8. Bumble bees, for honey

The children stripped some of the bark from suckers at the base of the basswood and tested it for strength.

They chewed some spruce gum, and examined the cones.

They gathered some quartz and tested it for hardness.

They tested the white ash for suppleness and noted the straight shafts of the viburnum.

How Tall Is That Oak Tree? *Any Season.* The sixth grade had been making shadow records. They had found that the oak tree at the end of the front walk cast a shadow 12⅓ yards long. Someone wondered how tall the tree was, and the group immediately accepted the problem of finding out. After some discussion it was decided that they could tell how tall the tree was by comparing the length of the yardstick's shadow with the length of the tree's shadow. The yardstick was held perpendicular to the ground and its shadow length was measured with a string stretched taut. A string was tied to the base of the tree and to a stake at the tip of its shadow. Starting at the base of the tree, the string record of the yardstick shadow was used as a measure along the tree-shadow string. The children chanted, "The tree is 1 yard long, the tree is 2 yards long," and so on until they finally concluded that the tree was about 14 yards tall. That figure was quickly reduced to feet. Someone noticed that the shadow lengths had changed while they worked. Another mentioned that they had not begun their measurement at the exact base of the shadow. The group decided that their measurement was not accurate. The term *approximate* was introduced and used with satisfaction.

Note. This study should be made where the entire shadow of the tree falls on level ground, and is done best about the middle of the day when the shadows are short. It could easily be shown that the same result could be obtained by dividing the length of the tree's shadow in yards, feet, or inches, by the length of the yardstick's shadow in yards, feet, or inches. The activity could be used also as a problem in ratio.

Hints About Outdoor Teaching

Plan and prepare. To teach out-of-doors is in many respects much like teaching in a classroom. In either, a purpose and a plan are essentials. Afterward, a summary of important learnings is desirable, as are some follow-up activities to relate the experience to the larger learning situation of which it is a part.

A clear purpose, which the children have helped to formulate and which they have accepted greatly increases the possibility of a successful experience. For brief outdoor trips, a simple statement, a question or two, or a short list of things to do or to look for is usually enough.

Plans need not be elaborate, but should be clearly worked out, preferably by teacher and pupils together. Children, especially the younger ones, need to know what is expected of them and how to go about achieving it.

For the teacher, preparation involves acquaintance with the study area. Has it the materials needed to achieve the purpose of the trip? Will it, at the time of the class visit, offer favorable physical conditions, such as sun, wind, slope, space, safety? What teaching possibilities has it in addition to those related to the purpose of the trip? Has it features that may interfere with the success of the planned study? What is the best general procedure? What arrangements need to be made so that everyone can see, hear, and take part? What preliminary information do the children need to profit most by the experience? Except that such slightly different questions as these need to be answered, teacher preparation is little different from that required for indoor teaching. If, however, using the outdoors is an unusual procedure, it is desirable to enlist the understanding and cooperation of the principal or some other administrative official.

With the teacher's knowledge of the area as a background, teacher and children can: (1) decide whether the class shall work as a whole, as individuals, or in groups or committees; (2) plan and assemble necessary materials and equipment; (3) delegate responsibilities; (4) decide on proper behavior; (5) make any advance preparation that is necessary, such as fact-finding; (6) plan to get permission if the trip is to involve a place or an activity that makes this necessary.

"Spelled out" as they have been here, these plans and preparations seem forbidding. Are they more so than a similar analysis of plans for classroom teaching?

Practice trips may help. Some training may be required before children recognize the out-of-doors as a place for study, not for play. Mrs. Perelli, in her record of field work with kindergarten children, describes on pages 10 and 11 the planning and practice trips that served to accustom her group to

field studies. Some teachers have found "window trips" a useful technique by which to introduce purposeful outdoor trips. A window trip is merely a minute or two of directed observation, from inside the classroom, of something out-of-doors. Perhaps a first grade is discussing plants. The teacher wishes to establish that trees are plants. She suggests that the children go to the windows and decide silently what is the largest plant visible outdoors. After the last observer has returned to his seat, the observations may be reported, discussed, and a conclusion reached. A visit to that "largest plant," if it is on or near the schoolground, could serve as a practice trip as well as a test of power to apply a generalization.

Allow for the unexpected. Although attention should be centered on accomplishing the primary purpose of a trip, plans should be flexible enough to permit the group to take advantage of unforeseen happenings. Often the unexpected appearance of a squirrel or a cardinal or the discovery of aphis-lion eggs among the aphids on a wild lettuce offers as valuable a learning experience as the specific purpose of the trip. Such opportunities cannot be produced at will.

Encourage participation. Recognize the discoveries and ideas of children and encourage them to contribute knowledge and related experience.

Plan to use all the senses. Feeling the warmth of an automobile parked in the sun on a hot day, or the sharpness of spruce needles, lifting objects of varying weights, tasting a bit of wood sorrel or peppergrass, smelling a crumpled mint leaf or a fragrant flower, hearing the hum of a bee or the call of a chickadee, seeing the way buds unfold in the spring are direct, vivid ways of learning.

Practice conservation, always. Materials should be collected cautiously, and with care not to destroy valuable study materials. If specimens are to be cut from trees or shrubs, the teacher may enlist the help of someone responsible, or be sure to take only parts that will not seriously affect the form of the plant. Stones, boards, or other objects that shelter ants or other small animals should always be replaced. Unless the purpose of the trip was to correct or improve an unfortunate condition (to reset an uprooted plant, for example) the area should be left as nearly as possible as it was found.

Make identification a tool of learning, not an end in itself. To be able to name a plant, an animal, a rock, or any other object is as satisfying to many persons as to know all members of one's group by name. Names are keys to information in books and other reference sources, and are an aid to the sharing of experiences and ideas. Yet ability to give specific names to all objects of study is not a necessity; and to know names alone is to have scant knowledge. Use correct names

of objects when it is possible to do so with reasonable certainty, but do not omit science studies because to you a tree is just a tree, and not a sugar maple or an elm. Much of value can be learned without specific names.

Don't be afraid to say, "I don't know." Rather, be afraid not to do so when you should, but add, "Let's try to find out." It is not possible to answer all questions. Much is still unknown. In most communities, however, many sources of information are available. The Leaflet Office will be glad to help answer questions or identify specimens.

Go outdoors often. Field teaching is not the easiest way to teach, but it should be a part of science teaching. Ordinary class numbers are not so easy to manage as are groups of 8 or 10, but it can be done. Field studies can be vivid and most rewarding learning experiences, to both teacher and pupil. They present opportunities for seeing, hearing, discovering, and growing in understanding and appreciation that cannot be duplicated in a classroom. Through frequent short trips most children soon learn how to work outside the classroom and their teachers gain in ability to guide outdoor studies. Longer excursions that are part of some school programs can then be undertaken with greater confidence.

Do outdoors those activities that yield richer experience there than they could indoors. Then use those rich experiences not only to contribute to science learnings, but also to stimulate purposeful reading in the classroom and at home; to help build a broader and more expressive vocabulary; to give new meaning to work with numbers; and new pleasure to art work – in short to play a many-sided part in the education of today's young people.

Redrawn from the Leader's Nature Guide, by Marie E. Gaudette. Used by permission of Girl Scouts of the U.S.A.

Useful References for Outdoor Teaching

The following sources are helpful in choosing content, supplying necessary background, and adapting outdoor studies to particular grades. The books and pamphlets on the teaching of science are especially valuable in organizing science experiences into meaningful units, and for suggestions of methods, materials, and content.

Science textbooks. Single copies of several series for the grade concerned and for the grades above and below are desirable. Some of the teacher's manuals contain excellent suggestions for presenting materials as well as additional background information for the teacher.

Past issues of the *Cornell Rural School Leaflet.* A list of those that are still available may be obtained from the Cornell Rural School Leaflet Office, Cornell University, Ithaca, New York. Files have been kept in many schools and libraries.

My Weekly Reader, teacher's edition, in a section, "Outdoors This Week," often suggests timely schoolyard studies.

Elementary-School Science and How to Teach It. By Glenn O. Blough and A. J. Huggett. Dryden Press, New York. 1951. 532 pages. (Or the abridged edition, *Materials and Activities in Elementary-School Science,* 1951, 310 pages.)

Teaching Science in the Elementary School. By R. Will Burnett. Rinehart and Company, New York. 1953. 541 pages.

Science for the Elementary-School Teacher. By Gerald S. Craig. Ginn and Company, New York. 1947. 561 pages.

Science in the Elementary School. By W. C. Croxton. McGraw-Hill Book Company, New York. 1937. 454 pages.

Science for Today's Children. The National Elementary Principals. Bulletin of the Department of Elementary School Principals, National Education Association, volume XXXIII, number 1. September 1953, 311 pages. This bulletin contains 61 articles by various authors intended "as a wide sampling of experience and practice."

Handbook of Nature Study. By Anna B. Comstock. Comstock Publishing Company, Ithaca, New York. 1939. 937 pages. An excellent source of suggestions for things to observe and of answers to many questions of fact.

Fieldbook of Natural History. By E. Laurence Palmer. McGraw-Hill Book Company, New York. 1949. 664 pages. Helpful illustrations and tabular information useful in many science studies.

Exploring Nature with Your Child. By Dorothy Edwards Shuttlesworth. Greystone Press. 1952. 448 pages. A recent book, by the editor of *Junior Natural History Magazine,* planned for parents and children, but a valuable help for any adult to use for and with children.

Teaching Elementary Science; Science Teaching in Rural and Small Town Schools. Both by Glenn O. Blough and Paul E. Blackwood. Bulletin 1948, Number 4, and Bulletin 1949, Number 5, Federal Security Agency, United States Office of Education, Superintendent of Documents, Washington, D. C. 40 and 55 pages.

Science for Children and Teachers. By Herbert S. Zim. Association for Childhood Education International, 1200 15th St. N.W., Washington, D. C. 1953. 55 pages.

The three following references have particular value in conservation studies.

Teaching Conservation in Elementary Schools. By Effie G. Bathurst. Bulletin 1938, Number 14, Federal Security Agency, United States Office of Education. Superintendent of Documents, Washington, D. C. 1940. 125 pages. (Out of print.)

Things to Do in Conservation, Teacher's Guide to Activities and Source Materials. By Byron L. Ashbaugh. Educational Series, Number 28, Department of Research and Education, Solomon's Island, Maryland. 1951. 41 pages.

Freedom and Plenty: Ours to Save. By Wilfrid S. Bronson. Harcourt, Brace and Company, New York. 1953. 124 pages. In this attractive, stimulating new book the author presents conservation problems, calls attention to each citizen's responsibility to help meet them, and discusses conservation practices. A particularly noteworthy chapter develops things you can do, "yourself, directly, to help conservation and so help save America." Directed to the 6-to-10 age group, the book will be interesting and valuable to readers of any age. The illustrations by Mr. Bronson are vivid, informative, and frequently humorous.

For suggestions on organizing and conducting field studies, whether the brief "walk with a purpose," or longer excursions, the following are helpful:

Cornell Rural School Leaflet, Teachers Number, September 1940, "Elementary-School Field Experiences in Natural Science," by E. L. Palmer, E. L. Gordon, V. E. Schmidt, and W. A. Thurber; and September, 1951, "Conservation, a Handbook for Teachers," by W. F. Clark, T. E. Eckert, H. A. Kerr, and F. E. Winch. 64 pages each.

Conservation Excursions. By Effie G. Bathurst. Bulletin 1939, Number 13, Federal Security Agency, United States Office of Education. Superintendent of Documents, Washington, D. C. 1940. 106 pages.

Field Trips. A Handbook for Leaders. Michigan Department of Conservation, Education Division, Lansing 13, Michigan. 1951. 26 pages. A comprehensive and thoroughly helpful pamphlet.

Science Excursions into the Community. By George E. Pitluga. Bureau of Publications, Teachers College, Columbia University, New York City. 1943. 154 pages.

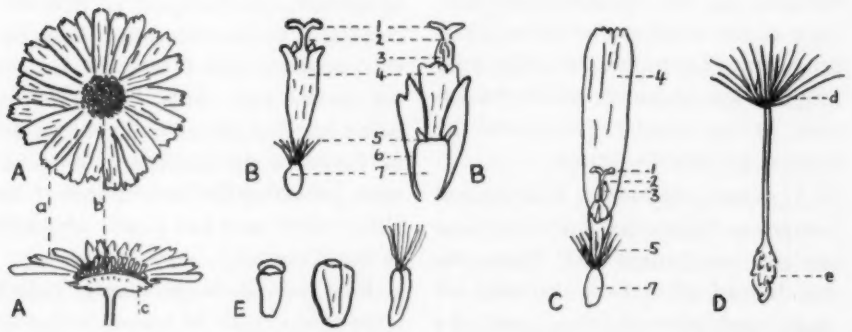
Some Explanations and Answers to Questions

The Composites

Dandelions and many other familiar flowers belong to the large plant family known as the *Compositae,* or the Composites. In this family the "flowers" are really masses of tiny flowers that form a close head and are attached to a common receptacle, such as one sees when he blows away the winged fruits of the dandelion. This close group of small flowers is surrounded by a common involucre, leafy in the dandelion, but differing in various composites. In burdock, for example, the involucre is made up of stiff, horny green bracts with the well-known hooked tips; in the cocklebur, the involucre of the seed-producing heads is the rough, prickly woody bur; in the pearly everlasting, it is made up of pearly-white papery parts. The blossoms of clovers and of some other kinds of flowers likewise are made up of small flowers, borne in close heads; but such flower heads lack an involucre.

The small flowers of Composites differ in their makeup, but two types are easily recognized: (1) the ray or ligulate flowers, in which the corolla is strap-shaped, like the so-called "petal" of a daisy; and (2) the tubular or disc flowers, in which the corolla forms a tube, as in the center portion of a daisy or a sunflower.

The Composite family may be



A. A radiate composite, with (a) ray flowers, (b) disc or tubular flowers, (c) involucre. B. Tubular flowers enlarged. C. Ray flower, enlarged. D. Dandelion fruit, enlarged, with (d) pappus and (e) seed-bearing portion. E. Fruits of three different composites. In B and C: 1, stigma; 2, style; 3, stamens (surround style); 4, corolla; 5, calyx (pappus); 6, chaff; 7, ovary.

divided into three groups, depending on the type or types of flowers in the head. These groups are:

1. *Radiate composites:* These composites possess both disc and ray flowers. The disc or tube-shaped flowers occupy the central portion of the head and usually are compressed into a cone or button-like mass. The ray flowers occupy the margin and are often incorrectly referred to as the "petals" of the flowers. The ray flowers are usually the more conspicuously colored; some common colors are yellow, bluish-purple, and white. Examples of this type of composite are daisy, black-eyed Susan, asters, Jerusalem artichoke, sunflowers, fleabanes, and goldenrod.

2. *Discoid composites:* These composites have only tubular or disc flowers. These flowers often are compressed so tightly within the involucre that the open-head appearance of the sunflower or aster is not apparent. Examples of this type are thistles, burdock, white snakeroot, Joe-pye weed, ragweed, and the garden bachelor's button.

3. *Ligulate composites:* This type of composite flower has only ray flowers and no central disc. Examples are chicory, dandelion, the wild lettuces and sow thistles, and the hawkweeds.

Knowledge of this kind is, of course, not a necessity for elementary-school children nor for many adults. It is, however, one step toward understanding an important generalization of science: that plants and animals are put into groups according to certain characteristics, and that knowing these characteristics helps one to know the large group to which a living thing belongs. That knowledge is helpful in identifying animals and plants one sees. This in turn aids in the study of their life habits and in determining their relation to other living things.

Leaf Coloration

One of the outstanding phenomena of autumn in New York State and in most other temperate regions is the change in color of the leaves of many trees, shrubs, and other plants from green to more brilliant hues. Many schoolyard studies can easily be based on these changes — some are suggested in the preceding pages of this Leaflet. Such studies inevitably lead to questions of *why* and *how* that are sometimes difficult to answer. The purpose of this discussion is to provide some help on this subject, but it should be remembered that much still remains to be learned about it. Professor L. C. Petry, of the College of Agriculture, provided the basic material for this article, and has kindly checked it for accuracy.

First, *why do leaves change color?* The green color of leaves is due to a mixture of substances known as chlorophyll, a name derived from two Greek words that mean *light green* and *leaf*. Chlorophyll is unstable. In nature it is constantly breaking down into colorless compounds. In summer, chlorophyll

usually is formed at about the same rate it is broken down, so the green color of plants remains about the same.

Without light, chlorophyll breaks down and no new supply is formed. Nearly everyone is familiar with this phenomenon. Green grass covered for a few days by a board illustrates it. A plant placed in a dark room loses its green color, but regains it when placed again in light, as grass does when the covering board is removed.

In autumn, many plants behave as they would if they were placed in the dark. Chlorophyll production slows and finally stops. The underlying cause of this change is not known. Light intensity cannot be the controlling factor, since the light of fall is not weaker than that of early spring. Possibly in some cases it is due partly to lower temperatures; possibly accumulation of waste materials in the leaves may be a factor; and possibly a combination of causes brings about the change. Drought, injury, and disease will often cause changes in color similar to the natural autumn changes.

Second, *why do different kinds of leaves change to different colors?* When chlorophyll formation stops and the green color disappears, a yellow color which has always been present in the leaves is unmasked. In other words, yellow color which has been hidden by the green of the chlorophyll becomes visible as the chlorophyll breaks down and is not replaced. Elms and hickories color in this way. The yellow color is due to pigments called *carotin* and *xanthophyll.* The same yellow is found in carrots, yellow corn, egg yolk, butter, and some yellow flowers.

The explanation of red color is more complicated. The color itself is produced by coloring materials known as *anthocyanins.* Anthocyanins produce the color of red beets, many red flowers (geranium is one), red cabbage, red begonias, the red in coleus leaves and the red, blue, and violet colors of many other plants or parts of plants. They cause the red color seen in many kinds of young leaves early in the spring, and in ripe apples of most varieties. Anthocyanins play a conspicuous part in the pageant of autumn colors, in the production of the bright reds of some maples, the purples of ashes, bittersweet, and some oaks, and of much of the brilliant beauty of the sumacs, including poison ivy (recognize it, admire it, but you had better not pick it).

How, under what conditions, and from what materials anthocyanins are formed are only partly answered questions; but these materials are formed in cell sap in leaves only where considerable accumulations of certain substances such as sugars or tannins and others are present. Anthocyanin is formed only when the leaves are exposed to fairly strong light. The color varies, depending on a number of factors. For example, when the cell sap is

acid in reaction, the color is usually red; but in the presence of alkaline conditions, blues and purples appear. The reds of sugar-producers, such as the maples, are well known; in oaks and sumacs tannins probably are an important color factor; the purples of ash, bittersweet, and some oaks are produced by anthocyanins, probably in the presence of alkaline rather than acid conditions; or variety in color may be due to combinations of coloring matter, or to a combination of conditions.

Often there are differences in color in various parts of a tree or even of a leaf. Some leaves or parts of leaves may color while the rest remain green. Children can sometimes, but not always, find explanations for such occurrences. Shaded parts of leaves may remain green or turn yellow, while exposed parts turn red. Leaves with broken veins may color beyond the break while the rest of the leaf is yellow or green, because removal of sugar or tannin as formed is prevented. Leaves of one branch may color due to injury to the bark; and dying trees, particularly girdled ones, may color brilliantly for the same general reason.

The final color of all leaves is brown, not due to a pigment or coloring matter but to changes within the leaf that have to do with decomposition of materials. Brown usually shows only in leaves on the ground or in those that hang on long past the usual time of leaf fall.

A third important question is *why are the fall colors more brilliant in some places and in some years than in others?* In spite of popular belief to the contrary, frost itself has little to do with the change of color. A series of temperature records begun shortly after schools open often will establish this without a doubt. (Considerable color had appeared in places near Ithaca before the end of the hot dry period of late August and early September of 1953.)

Temperature, however, is important. Low temperatures, averaging 45° F. or below, interfere with or prevent removal of sugars, tannins, and other substances, and also with the inflow of certain raw materials from the soil. This favors accumulation of color-producing materials in the leaves.

Red color, the chief factor in brilliant autumn coloration, is formed only in leaves exposed to fairly strong light. Sunshine is important in producing the brighter, more conspicuous colors.

Hence, low night temperatures, with or without frost, and bright sunny days, during the last weeks in September and the first weeks in October, are the proper conditions for bright color. These two conditions vary from place to place, and from year to year.

Leaf Fall

Sooner or later the leaves of plants cease to function and die. In temperate regions, many woody plants, including most of the common

broad-leaved trees and shrubs, regularly shed their leaves in autumn. Plants like these, that lose all their leaves at the end of each growing season, are called *deciduous* plants. Those that retain leaves through the year are known as *evergreen* plants. Even these evergreen plants have a more or less regular period when the older leaves fall. The white pine, for example, drops needles rather abundantly in late autumn, but the leaves it loses are usually those produced during the second or third year preceding their fall. The leaves of some evergreens persist as long as 8 or 9 years, and a life of 3 or 4 years is fairly common for leaves of such evergreens as the rhododendrons, some laurels, some pines, spruces, and other cone-bearers.

Persons who live in areas where autumn leaf fall is a regular event watch it year after year. But, to quote from an article on the subject, published in the Cornell Rural School Leaflet for September, 1922, and written by Arthur J. Eames, long a professor of botany at Cornell, "What a host of questions arise when we stop to observe and to think — to wonder a little about something which, because it happens every year, we are so likely to pass by as a matter of course."

Some of these questions follow; the answers, frequently with some modification, come chiefly from Professor Eames' article.

Does frost make the leaves fall? Frost has little to do, directly, with leaf fall. There have been warm autumns when the leaves have fallen before even light frosts. In some tropic lands where there is no frost, the trees drop their leaves as completely and as regularly as do those of our own climate, but their leaves are gone during a long season of dry weather. Some trees with the habit of losing their leaves in the fall in climates such as ours continue to color and drop their leaves even when transplanted to tropical regions. Red maples, transplanted to Florida, have shown this. Disease, injury, or even severe dryness, frequently cause leaves to color and fall when there has been no frost. A hard frost before the leaves are ready to fall often kills them, and they then remain on the trees for a long time. Branches partly broken from the trees during the growing season, frequently hold their dead leaves long after hard frosts.

What makes leaves that have remained in place even in severe summer storms fall so easily in autumn? Before a leaf falls, "usually in late summer or very early autumn, sometimes even in midsummer, a layer of tissue at the base of the leafstalk becomes somewhat different from the surrounding tissue. This layer [known as the *separation layer*] extends across the base of the leafstalk near where the leaf is attached to the twig except that it does not pass through the woody strands which connect the wood of the stem with the veins of the leaf. This is not always a flat, platelike piece of tissue;

often it is curved, saucer-shaped or even cup-shaped, with the concave side toward the leaf; sometimes it is more or less wave-like or tortuous. In some kinds of trees the layer is well up above the attachment of the leaf, so that after the leaf has gone, a piece of the leafstalk remains, covering and protecting the bud which lies close above it. [Note: The lateral buds of flowering dogwood are an example.] As the period of leaf fall approaches, this layer becomes more and more distinct, and finally breaks up into minute pieces, these becoming somewhat mucilaginous and partially dissolving. The leaf is then free from its attachment except for the woody strands and the outermost layer, or skin, of the leafstalk. These hold it in place until they are broken apart mechanically."

"When we turn to trees where the leaves are just falling, we find that, at a touch, the leaves separate from the stem, and that the wounds on the twigs are already covered by the layer of scar tissue which closes and protects them. This is perhaps not so thick nor so corky, and certainly not so dry, as it is a few days after the leaf has fallen, but yet it is well developed."

"If we look at the twigs where the leaves are gone, we find little scars, clear-cut like well-healed wounds. A dry, corky or woody layer covers the scars, which much resemble the rest of the surface of the twig."

"Why do leaves fall in great numbers on warm, sunny October days and again on quiet frosty mornings, when all the days between see only occasional ones come floating down?" "Different types of weather affect variously the development of the later stages of this separation layer, and, by hastening or delaying the rupture of the woody strands through it, produce the peculiarities in time and rate of leaf fall. On warm, sunny days, the leaves of some trees tumble down so thick and fast that in one day those trees are almost divested of their foliage. The elms and the birches are examples of trees most likely to behave in this way. The warm, dry air shrivels the leaf and shrinks the leaf base, causing it to pull away from the separation layer and to rupture, by its contraction, the anchoring threads of wood. Again, as the sun comes up some morning when the ground and the trees and the roofs are all white with frost, and when no breath of wind is stirring, we see so often the sugar maples, the poplars, and the sweet cherry trees dropping their leaves – not gaily, like the elms and the birches, from which they whirl to the ground in rustling showers, but in most businesslike fashion, the wet and sodden leaves falling heavily to the ground, rattling dully among the branches as they go. . . . Ice crystals form in the wet, sticky separation layer, and the developing expanding crystals rupture the woody bands and push out the leaf base. Then, when the sun thaws the ice,

the leaves are free. Of other weather types, only moist conditions have noticeable effects. The winds may blow and only a few leaves come down; but let there be a dash of rain or a day of very humid air, and see them come! The mucilaginous material of the separation layer holds the leaf tightly until it absorbs considerable moisture; then at once it dissolves away. With a gust of wind, the leaves are down."

Do all kinds of trees behave alike? The black walnut and butternut trees drop their leaves so early that their branches often are bare when other trees are bright with color. Birches usually shed their leaves swiftly, too. Oak leaves remain on the trees longer than the leaves of most other trees; and some beeches and oaks hold their leaves all winter, "brown and fluttering, till some warm, wet day in March." Occasionally a sugar maple remains clothed in dry, dead leaves through the winter; but "such trees are usually young and...only now and then do they hold all their leaves; usually only those of the lower branches and of the center manage to cling."

We cannot explain why these differences exist. "This is a question which we can answer only by saying that each kind of tree has, in this respect, its own habit, developed through long periods of time, just as each kind has its own month for flowering or germinating seed. We do know this much – that where the leaves fall early, the separation layer has been long developed; where they fall tardily, the layer develops rapidly in a few days, or, maybe hours."

Why do the leaves fall from some kinds of woody plants, why are they not kept all winter like those of the pines and the cedars? Woody plants in lands where there is a dry season and woody plants in our regions of cold winters achieve one common benefit from shedding their leaves. "If the leaves were held during this dry period, they would shrivel from lack of water and the whole plant suffer and probably die. When the easily dried-out leaves are disposed of, the plant is in no danger from the drought, for its stems are well protected against loss of water. So it is also with the deciduous plants of the North. In the cold and frozen ground the roots are not able to obtain the water necessary to the life of the leaves. Further, in the winter season the air is drier."

In the North another advantage is gained. "Leaves, if present... would become heavily laden with snow and ice, and much surface would be exposed to the high winter winds, so that severe injury from broken branches would surely occur."

"Then what of the evergreen trees of cold regions – the spruces, the pines and others? So toughened and protected against drying are the leaves of these plants that they endure the severe conditions without injury. So waxy-coated, so small and so slender are they that they hold

but little snow and ice, and the winds slip through them." The broad-leaved evergreens native to or planted in the North have similarly waxy-coated leaves. Some are protected in other ways from water loss or injury. Cold, dry days in winter, for example, find the leaves of the rhododendrons near my front door rolled to pencil-size.

To lose leaves or not to lose them seems, again, to be a way of growth, developed through long periods of time.

The Children's Leaflets for 1953–54

THE Fall number of the Leaflet will be called *Insect Homes.* Many kinds of insects make or cause structures in which their young, or sometimes they themselves, spend at least part of their lives. Insect galls, leaf mines, leaf shelters of various kinds, mud structures, and burrows of several types will be discussed and illustrated. These insect "homes" are common; many are conspicuous; they and their insect inhabitants are interesting illustrations of the variety of ways living things are fitted for their way of life and of how their lives are interrelated.

For the Winter number, to be entitled *Air Laboratories,* Verne N. Rockcastle, of the Science Department of Brockport State University Teachers College, will collaborate to present help in studies of the atmosphere, chiefly of weather and climate. Mr. Rockcastle has had special training in meteorology at Massachusetts Institute of Technology and taught the subject for more than a year in Army training courses. While many teachers may prefer to postpone extensive study of weather and climate until this Leaflet is available, weather records might be kept through as much as possible of the fall season; a group scrapbook might be made of weather news clipped from local papers and from other sources.

Woodlands in Spring will be the title of the last of the 1953–54 series. It has been a long time since the Leaflet has given help on the smaller plants of woodlands, especially the spring flowers. Within the past few decades flower-filled spring woodlands have decreased in area, and probably in number, partly because of the trend toward "living in the country." Conservation has become a problem and will receive attention in the new Leaflet.

The Radio Program, This Week in Nature

DIRECTED by Professor Richard Fischer, the radio series *This Week in Nature,* continues during 1953–54, as a service to supplement that of the Cornell Rural School Leaflet. Programs are presented on Fridays at 2:00 p.m. on Station WHCU – AM and FM, and on the Rural Radio Network – FM Saturday mornings at 9:30.

The Leaflet Survey

In May, 1952, approximately 1500 questionnaires concerning the Cornell Rural School Leaflet were sent to district superintendents and principals and to teachers in communities to which the Leaflet is regularly sent. Questionnaires were returned by 218 district superintendents, principals, vice-principals, and other officials, and by 227 teachers.

Question 1 of the inquiry to district superintendents and principals asked "For approximately how many years have you known the Cornell Rural School Leaflet?" Slightly more than one half reported acquaintance with the publication for 20 years or more, and nearly a third more for from 10 to 19 years. Some added that they had known the Leaflets as pupils in school, or as teachers, before they entered their present positions. Question 2, "For approximately how many years have you encouraged your teachers to apply for the Leaflets for use in their classrooms?" disclosed that about one half had done so for 10 or more years. Question 3 inquired "Approximately how many of your teachers have used the 1952–53 Leaflets?" All but 11 indicated that some of their teachers had used these publications; nearly one-half reported use by 10 or more of the teachers under their supervision.

Question 1 of the inquiry to teachers asked, "For approximately how many years have you used the Cornell Rural School Leaflets?" Of 227 replies received, 157 were from teachers of the elementary grades, 40 from teachers of science, and the remaining 30 from supervisors, librarians, or teachers of secondary-school subjects other than science. More than one-half of the elementary-grade teachers taught grades 4, 5, or 6, a fact that seems to indicate a special interest in the Leaflet by teachers at those levels. About a third of the teachers reporting had used the Leaflet for 20 or more years, another third for from 1 to 4 years; those remaining fell in the 10- to 19-year group, or gave indefinite answers. In reply to Question 2, "Have you used the Leaflets for 1952–53?" all but 11 answered "yes." The commonest reason for non-use was that the Leaflets arrived after the subject they presented had been studied.

Question 4 to district superintendents and principals and Question 3 to teachers concerned ways in which the Leaflets were used in schools. Both groups indicated widest use in science studies. Next in frequency were reference for teachers and pupils, supplementary reading material, as the basis for class discussions, and use in home and school projects. Leaflets were used in at least 10 other subjects or school activities, and 15 or more miscellaneous home or school uses were listed.

Question 5 of the superintendents' and principals' inquiry and

Question 4 of the teachers' questionnaire dealt with suggestions for improvement in the Leaflets or in the Leaflet service. The most frequent suggestion (by approximately a third of those reporting) was that the Leaflets be prepared for a lower grade level, with simpler vocabulary, simpler style, and simpler concepts. This the writer of the Leaflets for the past year has attempted to do. Use of larger type was suggested also. This was done in *Inviting Bird Neighbors,* the Leaflet for Spring 1953.

Illustrations were the subject of many and varied suggestions. Most of the comments favored abundant use of clear, understandable, educative illustrations, and many mentioned that children unable to read the text could and did learn much from the illustrations. Use of color was recommended. Some liked cartoons and some did not.

Comments on content indicated the popularity of suggestions for activities and projects, directions for experiments and help in outdoor study. Many topics for future Leaflets were listed. Most frequently mentioned were rocks and minerals, weather, soils, fossils, wild flowers, trees, birds, and conservation. Some of these have already been incorporated in our plans.

Some persons urged that the Leaflets be sent earlier in the year, a change which we intend to bring about.

Several responses suggested that teachers be given an opportunity to see the children's Leaflets before they ordered a quantity for class use. Some suggested that teachers of the primary grades be sent one copy of each Leaflet. These two changes are being inaugurated this Fall. The application card which accompanies this Leaflet contains a space where teachers of grades 1 through 3 may request one copy of each children's Leaflet. Teachers of grades 4 through 8 and others eligible to receive Leaflets in sufficient numbers for class use are given a choice between (1) requesting at once a quantity supply of the children's Leaflets for the year, or (2) receiving a single copy of each as it is published with the privilege of ordering later a supply for class use.

The Leaflet staff thanks those who gave us their judgment of the Leaflet service. It was encouraging to receive so many expressions of appreciation for the Leaflets, and so great a range of comments on their usefulness. Suggestions from Leaflet readers will always be welcomed. Let us know what you would like the Leaflets to be and do.

New Staff and New Quarters

SEPTEMBER, 1952, marked the change in responsibility for the preparation of the Cornell Rural School Leaflets from Professor E. Laurence Palmer to Associate Professor Eva L. Gordon and other members of the Division of Nature, Science and Conservation Education. The year 1953–54 brings new changes in the Division, which is part of the Department of Rural Education of the New York State College of Agriculture at Cornell.

Assistant Professor Theodore E. Eckert, who became a member of the staff in 1951, has entered new work at the State University College for Teachers at Buffalo. While at Cornell, Professor Eckert had taken major responsibility for the preparation of teachers of secondary-school science, and had contributed largely to the development of a conservation education program, especially through participation in the Arnot Forest Workshops in Conservation Education and in other workshops in and outside of New York State. During the past year he assumed responsibility for the radio program, *This Week in Nature*. Dr. Eckert, as Professor of Biology at Buffalo, plans to continue his interest and effort in conservation education.

Professor Philip G. Johnson, a member of the Division staff from 1935 to 1946, returns to assume its direction. During the years between 1946 and the present, Professor Johnson has been specialist for secondary-school science in the United States Office of Education in Washington. In connection with this work he has taught secondary-school teachers at several major universities and state colleges and has served as a special consultant to a number of state, county, and city school systems. During his professional career he has taught secondary-school-science pupils on a regular day-to-day basis for more than twenty years. He is co-author of a series of junior-high-school science textbooks and has prepared numerous professional articles and research reports. His activities in professional organizations of science teachers are numerous and substantial. Professor Johnson earned his bachelors and masters degrees at the University of Nebraska and his doctorate at Cornell University. In his new work at Cornell he will assume special responsibility for the undergraduate and graduate work pertaining to secondary school science teaching.

Assistant Professor Richard B. Fischer, whose chief interests are field natural history and nature photography, is the third member of the staff. Dr. Fischer took his bachelor's degree at Queen's College, in Flushing, New York, and his master's degree at Teachers College, Columbia University. He has had several years' experience as a teacher of secondary-school science. He recently completed a

four-year period of graduate study in the Conservation Department at Cornell, majoring in ornithology under the direction of Professor Arthur A. Allen.

Miss Dora Worbs, graduate assistant, completes the teaching staff. Miss Worbs is a graduate of Cornell University, an experienced teacher of junior- and senior-high-school science, and is now engaged in work toward a doctor's degree.

Within the next few months, the Division will move from its present space in Fernow Hall to newly prepared offices and laboratory on the ground floor of Stone Hall. There, for the first time in many years, the Division will be housed in the same building as the rest of the Department of Rural Education. Leaflet readers are invited to visit us there after the beginning of the New Year.

The 1953 Arnot Forest Workshop in Conservation Education

From a report by T. E. Eckert

The Fifth Conservation Workshop for Teachers, sponsored by the New York State Conservation Council, an affiliate of the National Wildlife Federation, and the State College of Agriculture at Cornell, was held August 17 to 21, 1953, at the Arnot Forest Conservation Camp. This workshop, like the others, was supported by a grant from the Council and the teaching staff, instructional facilities, and living quarters were provided by the College of Agriculture at Cornell University.

The total enrollment for the workshop was 54, including 17 elementary-school teachers, 27 junior-high-school and senior-high-school teachers, 1 school principal, 2 school superintendents, 1 state teachers college staff member, 1 representative of the New York State Education Department staff, and 5 workshop assistants. The assistants were students in the Division of Nature, Science, and Conservation Education at Cornell, preparing for careers in teacher education. The teachers represented 34 counties and boroughs in New York State.

This year eight 3-hour instruction periods were offered instead of the four 3-hour periods of previous workshops in the series. The program was divided into two series of four 3-hour sessions each. The teachers were organized into four groups on the basis of their subject matter fields and grade levels. During the first round, each group received one 3-hour period of field instruction under the leadership of Harry Kerr in soils, water, and land-use problems; Fred Winch in forestry and woodland management; Wilson Clark in stream improvement and general wildlife conserva-

tion; and T. E. Eckert, Helen Ross of State Teachers College, Fitchburg, Massachusetts, and Roger Ming of the Ithaca High School staff in teaching methods and materials. During the second round, each group met again with each of the above leaders for more advanced instruction, field activities, and teaching methods.

Special demonstrations and campfire programs added variety to the program. Efforts were made to meet the special needs of certain individuals by providing optional instruction during free periods.

This year for the first time a special Audio-Visual Aids center was set up. Film, filmstrip, and slide projectors were provided and representative conservation films, slide sets, and film strips were shown. A tape recorder and representative tape programs on conservation were available. Numerous books, magazines, periodicals, pamphlets, and other teaching aids were exhibited.

Over the past five years this Teachers Conservation Workshop series has provided training for 230 persons, 195 of them classroom teachers, representing approximately 120 schools. Fifty-three counties or boroughs have been represented.

The resulting "pool" of trained teachers has a tremendous potential for leadership in local and county workshops, training sessions and conservation weekends, a few examples of which may be cited.

At Norwich, Vail Shelden (1949) has actively supported conservation education in the school program. A conservation committee has been organized, a conservation park started, and one teacher training session held. At Geneva, Mrs. Hugh Glasgow (1950) has been active on the conservation committee and was instrumental in organizing several training sessions and a field trip for the teachers in the Geneva system. At East Greenbush, Mrs. Margaret Minch (1952) took the leadership in organizing a committee to plan a conservation weekend training session for teachers in Rensselaer County. This weekend training session, held in June 1953, was attended by more than 40 teachers from several schools in the county. The program was so successful that the group has planned another weekend training session at the Alps 4-H Club Camp in October.

More of these kinds of programs are needed. It is hoped that the statewide Teachers Conservation Workshop program may be continued and more local and county training sessions may be held for teachers in all areas of the State. More and better conservation training for school children is needed and such training is one way to assure it.

Fifteen minutes after the picture on the front cover was taken, each shadow had grown longer and moved eastward.

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